- User’s manual code MW6040

BabucM

BabucA

B A B U C /A/M

A portable instrument for acquisition, display, storage and processing of environmental data.

User's manual

Program Version 5.12

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PART 1 - INTRODUCTION

1.1. How to use this manual

It is not necessary to read the entire manual before beginning to use the instrument. It is sufficient to learn the contents of the second part entitled "HOW TO BEGIN". This part provides explanations about basic procedures relative to displaying data, performing a survey, with or without storage, and printing. The "Main Menu" of the instrument is explained in part three. In part four, called "MENU DETAILS", an explanation is given of the function of each menu option, in alphabetical order. Each explanation often includes practical examples and makes reference to other descriptions. This part may be read whenever the operator wishes to obtain further details on a particular subject. Part five provides descriptions of the error messages. Part six describes the procedures for connecting BABUC to sensors not produced by LSI LASTEM. Part seven includes a table explaining the operation codes associated to each class of sensor.

1.2. Before switching on the instrument

- The instrument is sturdy but not unbreakable - always handle it with care and avoid impacts.
- The instrument is not waterproof.
- The instrument is adversely affected by direct sunlight.
- When operating, the instrument has limited resistance against temperatures above +50°C and less than 0°C.
- Before using BABUC/A for the first time, it is good practice to charge it for at least 48 hours from the mains. Additional charging time will not damage the battery.

Attention: BABUC/A has (standard) rechargeable batteries which are recharged by connecting the instrument to mains with the power pack (mod. BSC010). BABUC/M is equipped with (standard) non-rechargeable alkaline batteries. If these batteries become low, replace them with new 9.0 Volt types (model 1604A).

1.3. Instrument description

BABUC is a line of instruments, sensors, accessories and software programs for the acquisition, display, recording and processing of a large variety of technical parameters, managed in an integrated information environment.
The BABUC instruments have universal inputs that can receive any combination of different sensors, and can automatically recognize them and respond with compatible functionality.
Depending on the use, the available levels of information processing are, in increasing order:

- Immediate display of all instantaneous values and main processes of the measurement in progress.
- Data recording, creation of a local archive of the surveys performed, and selective printing of the data and main processes.
- Transfer of the local archive to a PC, creation of large-scale archives, and processing using specialized application programs or with the aid of electronic spreadsheets.
- Remote control of acquisition systems via modem, management of up to 32 networked BABUC instruments.

The BABUC instruments are well adapted for use as "portable" instruments for immediate data acquisition, either as "fixed" or "semi-fixed" data acquisition stations even for long periods of time.

1.3.1 Models

Code	Model	Description
BSA020	BABUC/M	Multi-datalogger 6 inputs, 5,000 samples in memory, serial port RS232
BSA010	BABUC/A	Multi-datalogger 11 inputs, 20,000 samples in memory, serial port RS232
BSA012	BABUC/A	Multi-datalogger 11 inputs, 50,000 samples in memory, serial port RS232
BSA014	BABUC/A	Multi-datalogger 11 inputs, 110,000 samples in memory, serial port RS232

1.3.2 Main Features

MEASURABLE PARAMETERS: Sensors with different sizes and different physical properties can be simultaneously connected to BABUC because it can recognize each one and reconfigure its electronic circuits and information processing activities accordingly.

1 - Temperature
2 - Relative humidity
3 - Thermal flow
4 - Radiation
5 - Illumination
6 - Atmospheric and differential pressure
7 - Air speed
8 - Gas concentration
9 - Noise
10 - Rotation speed
11 - Water level
12 - pH
13 - Displacement

The same parameter often has sensor models with different physical measurement properties, such as the air speed and relative humidity, for which the most suitable must be selected for the particular requirement. The BABUC instruments also receive non-LSI LASTEM sensors and standard analogue signals in mV.

PROGRAMMABILITY : BABUC instruments can be programmed to adapt them to the broadest requirements. The parameters are factory-set for general purpose use. However, the operator will quickly learn to modify them to meet his needs. The programmable settings fall into four categories: survey, system, communication and utility.

Survey settings: Related to the specific measurements being performed, and are:

a) Choice between memorizing the data or just displaying them
b) Setting the survey number
c) Setting the date-time to begin measuring automatically
d) Setting the survey duration

Communication settings: Related to communication between BABUC and printers or PC, and are:

a) Setting the transmission speed (bit rate)
b) Setting the protocol ID for networked BABUC instruments
c) Information about serial line activity

Utility settings: Related to the general operation of the instrument, and are:

a) Setting the system date/time
b) Setting the keyboard protection password
c) Setting beeper activation/de-activation
d) Setting the display automatic switch-off time

System settings: Related to the treatment of the various types of sensors, and are:
a) Setting the acquisition rate for each sensor (from 1s to 24h)
b) Setting the time period during which power is supplied to the sensors that need it.
c) Setting the engineering parameters of the sensors
d) Setting the calibration parameters
e) Setting the standard values for the non-acquired parameters used in some calculations (gravity, ambient temperature, height above sea level, atmospheric pressure, emissivity, pipe geometry and room volumes)
f) Use of the differential pressure sensor for measuring the pressure or air speed with a Pitot tube.
g) Use of the ± 4 V channel
h) Battery level storage

DATA DISPLAY: During surveys, it is possible to display the data in two formats. The "synthetic" format lists the most recent acquisition values of all parameters. The "statistical" format, for each parameter, displays its most recent value and the difference with respect to the previous one; the minimum and maximum data values with date/time; the mean and standard deviation from the beginning of the survey or since the last update performed. A series of information is also available about the survey in progress: current date and time, beginning/end of survey, available memory, etc.

PRINTING: BABUC can be connected directly to any serial printer. 5 types of print formats are available:
1) List of archives
2) Instantaneous survey values
3/4) Survey statistics based on requested time period (tabular and graphic format)
5) Active parameters on the instrument
6) ASCII table

DR CALCULATION: From Version 5.02 of the program, BABUC when connected to the following probes:
- Air speed and turbolence (BSV105)
- Temperature
- Calculates, visualizes and memorizes (if a memorizable relief is made), the risk index from air currents (UNI EN Iso 7730 September 1997)

WBGT Calculation: From version 3.9 of the program, when BABUC is connected to the following probes:
- Globothermometric probe and Natural ventilation wet bulb probe
- Dry temperature probe.
It calculates, displays, and stores (if a survey with storage is performed) the WBGT thermal stress index (ISO7243) in the WGBT indoor and WBGT outdoor versions. If BABUC is connected to the following probes :
- Globothermometric probe and Natural ventilation wet bulb probe
It calculates, displays, and stores (if a survey with storage is performed) the WBGT thermal stress index (ISO7243) only in the WGBT indoor version.

LUMINOUS INTENSITY CALCULATION: From version 4.02 of the program, when BABUC is connected to the following probe: Luxmetric probe
It calculates, displays and stores (if a survey with storage is performed) the derived parameter “luminous intensity”. It expresses the luminous flux of a source in a specific direction, per unit of solid angle. In the calculation this measurement uses the standard parameter “Distance from light source” which must then be set. If the “Distance from light source” is equal to zero, the “luminous intensity” parameter is not calculated nor is it displayed or stored.

UVA DENSITY CALCULATION: From version 4.02 of the program, when BABUC is connected to the following probe: Lux/UVA combined probe (BSR107)
It calculates, displays and stores (if a survey with storage is performed) the derived parameter “UVA Density”. It expresses the emission of ultraviolet radiation (UV-A) with respect to the lighting level of the lighting sources in the rooms where objects are present which may deteriorate due to photochemical reactions.

AIR DELIVERY, AND NUMBER OF AIR CHANGE CALCULATIONS: In version 4.0 of the program, when BABUC is connected to anemometric probes (hot wire, fan and Pitot tube anemometers) and to a temperature probe and after setting the dimensions of the pipes and rooms other than zero, the instrument will calculate the following parameters:

- Air flow: After setting the geometry and dimensions of the unions, pipes and rooms, BABUC will calculate the volumetric (m3/sec.) and mass air delivery (Kg/sec.). The pipe factor can be set from 0.1 to 1 (ASHRAE Handbook)
- Number of air changes: After setting the volume of a room, BABUC calculates the number of air changes (N/h)

CALCULATION OF THE WALL THERMAL CONDUCTIVITY ("K" FACTOR): in version 4.01 of the program, when BABUC is connected to a flowmeter probe (BSR240), environment temperature probes and contact temperature probe, it calculates the following values :

- Thermal flow. W/m^2
- Overall thermal conductivity ("K" factor). $W/(m^2K)$
- Internal surface↔internal air thermal conductivity factor (Ki - αi) $W/(m^2K)$
- External surface↔external air thermal conductivity factor (Ke - αe) $W/(m^2K)$

HEAT INDEX AND HEAT STRESS INDEX: From the Version 5.07 of the program BABUC, when connected to the Humidity probes BST101, BST102, BST104, BST105, BST107, BST116, BST118, BST120, BST122, BST127, BST201, BST216, BST218, BST301, BSU102, BSU104, BSU106, BSU400, BSU401, BSU402, BSU403, BSU402.1, BSU403.1 and BSU431, calculates the following indices:

- Heat index
- Heat Stress Index

UV INDEX CALCULATION AND UV EXPOSITION LEVEL: From the verion 5.07 of the program BABUC, when connected to the UVB and UVA probes calculates the following indices:

- UV index
- UV exposition level

CALCULATION OF ELEMENTS OF DISCOMFORT FOR DIFFERENCES BETWEEN VERTICAL AND FLOOR TEMPERATURES: The BABUC program version 5.03, when connected to the floor and wall temperature probe (BST230), and air temperature probe, calculates the following indices:

- Percentage of dissatisfied due to warm or cool floor
- Percentage of dissatisfied due to vertical air temperature difference.

RADIANT ASYMMETRY CALCULATION: From Version 2.1 of the program, when connected the radiant asymmetry probe (BSR231 with references to the EN 27726), and an air temperature probe, BABUC shows and, in case, stores (if a survey with storage is in progress), the following values:

- Net Radiation W/m^2
- Radiometer temperature in °C
- Air temperature in °C
- Planar radiant asymmetry temperature (Δt_{pr}) (UNI EN 27726)

CALCULATION OF DISSATISFIED DUE TO RADIANT ASYMMETRY: From the version 5.03 of the BABUC program, when connected to a Net radiometer probe, calculates the following index:

- Percentage of dissatisfied due to radiant asymmetry (%) (UNI EN 27730) – only Vers. > 5.02

INPUTS: In the "non-dedicated inputs", the instruments are capable of receiving and recognizing signals from sensors, automatically configuring itself accordingly. There are two "dedicated inputs": one for hot-wire anemometric LSI LASTEM sensors, and the other for -4+4 V voltmetric signals.

	BABUC/M	BABUC/A
Inputs capable of automatically recognizing signals from analogue sensors: (thermocouples, thermoresistors, thermistors, thermopiles and potentiometric sensors with mA and mV outputs, etc.)	4	8

Inputs capable of automatically recognizing signals from impulse sensors (e.g. anemometric with fan)	1	1
Dedicated input for hot-wire LSI LASTEM sensor	1	1
Dedicated input for ± 4 Vdc	-	1
Total number of inputs	6	11

ACTUATORS: Actuators associated to all analogue inputs supplying 9 V unstabilized power, maximum 0.2 Amp each, with total simultaneous maximum: 0.6 Amp.

MEMORY: BABUC has two types of memory: dynamic (RAM) and static (EEPROM). The instrument does not lose data once it is switched off.

	BABUC/M	BABUC/A		
Model Code	BSA020	BSA010-BSA011	BSA012-BSA013	BSA014-BSA015
Total memory (in Kb)	32	64	128	256
Maximum no. of samples that can be stored in memory	5,000	20,000	50,000	110,000

The amount of memory used depends on the programmed acquisition rate and the number of sensors connected to the acquisition device.

ACQUISITION RATE: Acquisition rate is defined as the time interval between two successive acquisitions. The acquisition rate can be programmed for each individual sensor from 1 second to 24 hours. The time necessary for the instrument to acquire each input is 1 second.

CONNECTION OF NON-LSI LASTEM PROBES: It is possible to connect non-**LSI LASTEM** probes. In this case, the operator will use terminal connectors to attach the probes electrically and to carry out the parameter setting procedure. Once this has been done, BABUC will automatically recognize the probe as any other **LSI LASTEM** probe.

PC SOFTWARE: IngoGAP IG is a program for the management of acquired data measured from the Babuc data logger line.The program has been realized with a “multi-level” logic in that it can be used by both users, who require graphs and tables of acquired data with a few clicks of a mouse and those users who are more demanding and require more advanced functions, for example, personalised graphs and reports
The InfoGap program is available in two versions: IG-Basic and IG-Advanced:

Features	**IG-Base BSZ300**	**IG-Advanced BSZ302**
Download data by means of “Data browser”	ϒ	ϒ
Classification of surveys within the “Data browsers”		ϒ
Display data graphs and tables	ϒ	ϒ
The input and use of data in “Folder”		ϒ
Use of the “calculator” feature		ϒ
Possibility to join with “Microclima” moduls		ϒ
Possibility to join with “Automatic data downloading” moduls		ϒ

MICROCLIMATE is an additional module of the InfoGAP program for the calculation of some of the most used and known microclimatic indices from the international standards (ISO standards).The microclimate modules must be used with the InfoGAP-Advanced (BSZ302) package.

Cod.	**Description**
BSZ303	Microclima modul for moderate enviroments.
BSZ304	Microclima modul for hot enviroments.
BSZ305	Microclima modul for cold enviroments.

1.3.3 Technical Features

Description	BABUC/M	BABUC/A
No. of inputs	6	11
No. of actuators	4	8
Data output	RS232-DCE	RS232-DCE (RS485 opt.)
EEPROM memory	32 K	64 K (128, 256 kB opt.)
A/D converter	12 bit	
Clock	SW clock to be reset at each switch-on	HW clock with rechargeable 1 year backup battery
Display	LCD 20 char. X 4 lines	
Keypad	21-key numerical with autorepeat	
Power supply	9 Volt 2 internal 9V AlkMn. batteries	9 Volt 6 internal rechargeable 1.2V batteries
Average power consumption (without actuators)	17mA	5mA
Operating conditions	0-50°C	
Construction	Anodized aluminum casing	
Dimensions	112x200x33 mm	222x129x41
Weight	850 g	1.4 Kg
EMC	"Residential settings" emission EN 55022 "Residential settings" immunity EN 61000-4-3	

1.3.4 Resolution and precision of input channels

Input types	Probes	Range	Sub-ranges	Resolut.	Accur.
Inputs Analogue	Pt100	-50 ... +600	-50 ...+150	0.03	± 0.15
			+150 ... +600	0.06	± 0,3
	Ni100	-40 ... +180	-40 ... +90	0.03	± 0.15
			+90 ... +180	0.06	± 0.3
	TS/S1	0 ... +44	0 ... +44	0.03	± 0.1
	TS1	-50 ... +60	-50 + 60	0.03	± 0.15
	TS/B	-50 ... +140	-50 ...0	0.02	±0.2
			0 ... +140	0.03	±0.15
	TC/J (IPTS) TC/J (DIN)	-50 ... +600	-50 ...+500	0.2	± 0.5
			+500 ... +600	1	± 2
	TC/K (IPTS)	-200 ...+1300	-200 ...+700	0.2	± 0.5
			+700 ...+1300	1	± 2
	TC/T (IPTS)	-200... +200	-200 ... +200	0.2	± 0.5
	TC/S (IPTS)	0 ... +1600	0 ... +1600	1	± 2
	TC/E (IPTS)	-200 ...+1000	-200 ...+400	0.2	± 0.12
			+400 ...+1000	1	± 1
	Direct signal in mV	-10 ... +300	-10 ... +30 mV	8µ V	±17 µV
			+30...+300 mV	50µV	± 100 µV
Voltmetric	Direct signal in V	± 4 Vdc	-4 ... +4 Vdc	1 mV	± 4 mV
Impulse	Impulse signal		0 .. 65.535 imp.	1 imp.	-

The tolerances indicated are guaranteed when the instrument is re-calibrated every year.

PART 2 - USING BABUC

2.1. How to prepare the instrument for measuring

a) Place the instrument on a surface or on a stand using the special columns (BVA306 and BSD020)
b) Place the sensors in the measuring location;
The sensors may be mounted on a stand (using the column BVA306) or placed according to use.
c) Connect the sensors to the instrument, making sure that dedicated inputs are used for the correct type of sensors. The sensor connector is marked with an arrow; the connector must be fitted by turning the arrow toward the front of the instrument. (Warning regarding BABUC/A only: the arrow on the serial cable BSH100 connector points toward the rear).
d) If possible, use 220 V ac mains power supply. (BSC010)

WARNING: do not fit the sensors into the relevant inputs unless the instrument is switched off

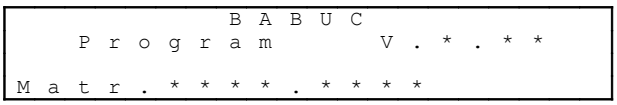
2.2. Keyboard

The keyboard consists of 10 alphanumeric keys, 10 function keys and 1 switch on key. Keeping the key pressed the autorepeat function is automatically activated.
The normal values of the keys are shown below:

ON	Main switch
Arrows △ ▽	In the data input menus, these arrows shift the line cursor across the lines containing write fields. In the option menus, they shift the arrow indicating the selection confirmed by "IMMIS". In the data display mode, when the list contains lines in excess of display capacity, the arrows scroll the list by line or continuously.
Arrows ◁ ▷	They shift the character cursor horizontally across the write fields. Movement is circular and unlimited. In some screens, the information item format changes.
pg △ ▽	These shift the display page forward and backward in lists with several pages.
immis	This has the customary input, confirmation and start functions.
esc	To exit from the screen mask currently displayed and return to the mask immediately prior to it along the branch path. It is possible to exit the different options inside the menus by pressing this key until the main menu is obtained. However, when measuring, it is necessary to "end the survey" in order to return to the main menu.
F2/-	This is used as the "PAUSE" key while computing the statistics in the display masks, without stopping any data storage in progress. It inserts the character "-" in numerical inputs, wherever necessary. Switch on and off the display back lighting (optional)
F1/,	This generates a decimal point wherever requested. (Input of radiometer Coefficient, Channel input/output engineering); it clears the statistics during the computation of statistics in the display masks.

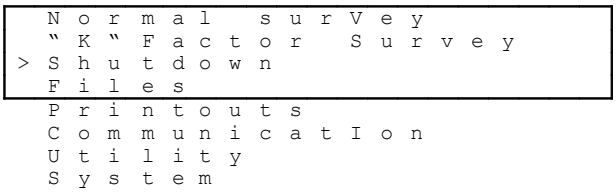
2.3. How to switch on the instrument

Press the "ON" key. After a brief countdown, the following message will appear on the screen:



showing the number of the resident program, the serial number of the instrument, and the program language. If "IMMIS" is pressed, the main menu will be shown. If the operator does not press "IMMIS", the instrument will be switched off automatically after one minute as a safeguard against inadvertent activation.

2.4. How to switch off the instrument



Return to the “Main menu” to switch off the instrument.
Shift the cursor to "SHUTDOWN" and press IMMIS

WARNING: Wait some seconds before switching the instrument on again.

2.5. Program organization

BABUC opens with a cascade type menu, i.e. making your initial selection will display the various sub-options available. The main menu offers the following options:

Survey

"*Survey*" can be used to set all parameters allowing BABUC to acquire, display and store data and to run or interrupt a survey. The “K” Factor survey only measures the “K” coefficient of the walls.

Shutdow n

"*Shutdown*" disables the instrument.

Files

"*Files*" is used to display all the information regarding memory space requirements and Survey cancellation.

Comun.

"*Communication*" is used to modify options for the connection between BABUC and PC or printer.

Printouts

"*Print*" enables resident files to be printed, with various logic configurations, using a serial printer directly connected to the instrument.

Utilities

"*Utilities*" provides information on the operation of the instrument, excluding information about survey settings or the connected sensors.

System

"*System*" is used to modify the operating characteristics of the sensors that can be connected to the instrument.

2.6. Using the instrument without data storage facility

It is possible to take measurements without data storage, while retaining the following functions: display of instantaneous, mean, maximum and minimum values, plus the variation and standard deviation for all data.

“INSERT DATE/TIME” (BABUC/M only)

The BABUC/M model is equipped with an internal clock without buffer batteries.
Each time the instrument is switched on for a survey, the clock must be reset. In UTILITY->SYSTEM DATE/TIME the following is shown :

```
00/00/00   00:00:00
System date/time
dd/mm/yy   hh:mm:ss
--/--/--   --:--:--
```

Insert the date/time and press “IMMIS”. This operation will permit the date/time of the minimum and maximum values ; it is not compulsory.

"SURVEY"

Once the instrument has been switched on by using the "ON" key, BABUC executes a brief countdown displaying the program Version and Serial Number. If "IMMIS" is pressed, the following is shown:

```
> Normal   surVey
  “ K“ Factor  Survey
  Shutdown
  Files
  Printouts
  COmmunicatIon
  Utility
  System
```

Shift the selection arrow to "SURVEY" and press "IMMIS" - the following selection will be shown:

```
> Without   stOrage
  With   storaGe
```

Shift the selection arrow to "*Without Storage*" and press "IMMIS". After approx. 10 seconds, the following mask will appear :

```
  Survey   witHout
  storage   in   progr
```

This indicates that the measurement is “in progress” and that the instrument is acquiring data. It is therefore possible to view the values by following the procedure described in section "8" of this chapter.

"END OF SURVEY"

To complete the survey, use the "ESC" key to return to the message: "SURVEY WITHOUT STORAGE IN PROGRESS" and press "ESC" again. The following will be shown:

```
> VisualizatIon
  End   of   SurVey
  New   Subsurvey
  Utility
```

Shift the selection arrow to "END OF SURVEY" and confirm your selection by pressing "IMMIS"; press "ESC" to return to the main menu.

2.7. Using the instrument with data storage

BABUC can be used to store data. It can acquire data (identified by number and sub-number) wherein each parameter can be acquired according to programmable modes.
The stored data can be subsequently printed directly or transferred to a PC.

"SURVEY"

Access the main menu and shift the selection arrow to "SURVEY", then press "IMMIS" to show the following selection:

```
> W i t h o u t   s t O r a g e
  W i t h   s t o r a G e
```

Shift the selection arrow to "*With Storage*" and press IMMIS; the following message will appear:

```
> E x e c u t i o n
  S e t u p
```

BABUC will prompt the operator to "Set" a Survey or "Execute" a Survey with the logic of the last setting executed. Shift the selection arrow to "Set-up" and press "IMMIS". The following clock setting mask will appear: (BABUC/M ONLY)

```
0 0 / 0 0 / 0 0   0 0 : 0 0 : 0 0
S y s t e m   d a t e / t i m e
d d / m m / y y   h h : m m : s s
- - / - - / - -   - - : - - : - -
```

The BABUC/M model is equipped with an internal clock without buffer batteries.
Each time the instrument is switched on for a survey or to print, the clock must be reset. Insert the date/time and press “IMMIS”. A screen mask will appear for programming the start and duration of the Survey.

```
            n n / n n / n n   n n : n n
            d d / m m / y y   h h : m m
S t a r t : 0 0 / 0 0 / 0 0   0 0 : 0 0
D u r a t i o n :     0 0 0   0 0 : 0 0
```

x = current date and time
n = current date and time
y = duration in hours of the set survey

By leaving the values on their respective zero settings the operator selects manual start and unlimited duration of Survey. The manual survey started is mode is performed with the command "EXECUTION" while it is stopped with the "END SURVEY" command. If instead, date and/or time of survey start are specified, the instrument will start and finish the survey when requested.
The maximum programmable duration is 999 days.
After completing the selections, press "IMMIS" and the following screen will appear:

```
I n s e r t   p r o b E s
f o r   c h e c k i n G
> C h e c k
  E x i t
```

Press "IMMIS" to carry out the "CHECK" and wait approx. 10 seconds.

After a few seconds the following list will appear:

```
C h .   i n   u s e :          R a t e s
x   y                    h h : m m : s s
```

The list shows the number of the input (x) to which the sensors are connected, the name of the relative parameter (y) and the acquisition rate assigned to the sensor in question.
By pressing the "Right arrow" key you can display the number of the operative sub-code for access to the SYSTEM -> MOD.PARAM. menu (see part 4 : MODIFY CODE PARAMETERS, ACQUISITION RATES).
Pressing "IMMIS" will cause the following message to appear:

```
D o   y o u   c o n f I r m
c o n n e c t e d   p R o b e s
  N O
> Y E S
```

BABUC is asking if the operator wishes to confirm the connected sensors.
Shift the cursor to "YES" and press "IMMIS"; the following message will appear:

```
M e m o r y   a v a i L a b l e
c o m p u t e d
D a y s     x x x
H r s       x x : x x : x x
```

BABUC thus displays its available memory capacity for a measurement based on the set duration and acquisition rates. Press "IMMIS" and the following message will be shown:

```
> A c c e p t   c o n F i g
  S h o w   a c q .   R a t e s
  S e t   a c q u i s I t . r a t e S
```

The operator may:
1) Accept the configuration.
2) Display the acquisition rate of the connected sensors.
3) Set new acquisition rates to optimize the measurement. At this point the operator can change the collective multiplication factor for the rates of all the sensors connected. This means that the operator can multiply, by a common factor, the individual acquisition rate set in the SYSTEM -> MODIFY SENSOR CODES menu for each sensor (see ACQUISITION RATE, FACTOR M). If the acquisition rate is changed, BABUC will display the revised memory space availability asking if the operator wishes to accept the new configuration. BABUC may show an indication that the ACQUISITION RATE is too high for the number of sensors connected.
Warning: the minimum rate in seconds for each sensor is equal to the number of sensors connected.

The MINIMUM ACQUISITION RATE is the shortest time passing between an acquisition and the following one. The Babuc minimum acquisition rate is 1 second multiplied for the number of LOGICAL CHANNELS +1 (Battery Value)
Ex.: When we connect the psychrometric probe BSU102 to the Babuc, the minimum acquisition rate is 5 seconds.The BSU102 probe, occupies two channels of the Babuc, but the display visualizes:

1. Ta (Environmental temperature)
2. tuvf (wet bulb temperature)
3. R.H. (relative Humidity)
4. TPR (dwe point temperature)
5. Battery Value.

BABUC prompts the operator to assign the survey identification number and suggests the number immediately after the previous one. The operator may accept or change it.
After having accepted or set the number, press "IMMIS" and wait approx. 10 seconds during which the instrument stores the configuration. The following message will appear:

```
A c q u i s i t i o n
s e t u p   O K
```

At this point the operator can now start the survey he has just programmed.
Press "IMMIS" and BABUC will return to the selection below:

```
> E x e c u t i o n
  S e t u p
```

The operator has the choice of executing the survey, resetting it or returning to the main menu by pressing "ESC". The set-up parameters are stored in EEPROM memory so that they will remain available even after the instrument has been switched off.

EXECUTION
"EXECUTION" starts the previously programmed survey.

```
S u r x x x / x x x   I n   p r o g r .
            d d / m m / y y   h h : m m
S t a r t :
E n d
```

"BABUC" checks the sensors to ascertain whether they correspond to the sensor type and position set at the last "survey setting" executed. If the check result is negative, an error message will appear. (SURVEY ERROR : PROBES DO NOT CORRESPOND). If the check result is positive, BABUC starts the measurement and displays a screen mask with the following information:
- survey and sub-survey number
- survey "In progress", i.e. acquisition has begun, or survey "Activated", i.e. BABUC is awaiting the programmed time before starting.
- current date and time.
- date and time to start the survey
- survey duration.

The survey will continue for the entire programmed duration. However, it may be stopped manually at any time using the "END OF SURVEY" option.

"END OF SURVEY"
To end the survey, return to the following mask:

```
S u r x x x / x x x   I n   p r o g r .
                           h h : m m
S t a r t :
E n d
```

Press "ESC":

```
> D i s p l a y
  E n d   o f   S u r V e y
  N e w   S u b s u r V e y
  U t i l i t y
```

Shift the selection arrow to "END OF SURVEY". If you are performing a measurement with memory storage, confirm your choice by pressing "IMMIS". Press "ESC" to return to the main menu.

2.8. How to display data during acquisition

While the measurement without storage is in progress, the current mask will be the following:

```
  S u r v e y   w i t H o u t
  S t o r a g e   i n   p r o g r e s s
```

Or, if the survey is performed with the storage facility, the mask shows:

```
S U r x x x / x x x   I n   p r o g r .
            d d / m m / y y   h h : m m
S T a r t :
E N d :
```

In any event, if "IMMIS" is pressed, the following options are suggested:

```
> V i s u a l i z a t I o n
  E n d   o f   S u r V e y
  N e w   S u b s u r V e y
  U t i l i t y
```

When the cursor is on "Visualization" the following options are suggested:

```
> S y n t h e t i c   D a t a
  S t a t i s t i c a L   d a t a
  R e s e t   s t a T i s t i c s
```

During the measurement, if BABUC is set to calculate the derived parameters, the list of the standard parameters from which they derive can be displayed in the “Standard quantities” menu.

```
> S y n t h e t i c   D a t a
  S t a t i s t i c a L   d a t a
  R e s e t   s t a t I s t i c s
  S t a n d a r d   q U a n t i t i e s
```

With the "SYNTHETIC VISUALIZATION", BABUC displays all the instantaneous values, for example :

```
1   T          2 3 . 5 4   " C
2   U R        7 8 . 6 8   %
```

Press the right arrow to explode the description of the parameter.

1 "STATISTICAL DATA VISUALIZATION" (General parameters)
Select STATISTICAL DATA to display the following mask (example)

```
4     T                 " C              *
I n s   x x x . x x
M i n   x x x . x x
M a x   x x x . x x
A v e   x x x . x x
D S t   x x x . x x
D i f   x x x . x x
```

The following is displayed for each sensor:
- instantaneous value. (Ist xxx,xx)
- maximum dated value* (Max xxx,xx) -> (dd/mm/yy hh:mm:ss)
- mean* (Med xxx,xx)
- minimum dated value* (Min xxx,xx) -> (dd/mm/yy hh:mm:ss)
- standard deviation* (Dst xxx,xx)
- Difference between the last two instantaneous values (Dif xxx,xx)

A flashing light (*) also indicates the operation of the statistical computation

Press the “right arrow” key and the mask will become:

```
4      T e m p e r a t U r e              *
I n s      z z z z z z Z / y y y y y y y
M i n d d / m m / y y    h h : m m : s s
M a x d d / m m / y y    h h : m m : s s
A v e            d d d / h h : m m : s s
D S t
D i f                    h h / m m / s s
```

- The number of acquisitions from the beginning of the measurement (yyyyyyy)
- The number of acquisitions from the last "RESET STATISTICS" (zzzzzzz)
- The date/time in which the minimum value occurred (Min dd/mm/yy hh:mm:ss)
- The date/time in which the maximum value occurred (Max dd/mm/yy hh:mm:ss)
- The time elapsed from the beginning of the measurement or from the last " RESET STATISTICS " (ddd/hh:mm:ss)
- The real acquisition rate of the probe (hh/mm/ss)

Press the “left arrow” key will restore the previous mask.
Press "PgUp" or PgDn" to change the channel being displayed.
During statistical displays you can scroll the screen using the "down arrow" and "up arrow" keys. Display the other channels with "PgUp" or PgDn" and stop the statistical calculation by pressing the "F2/-" key. The "F2/-" key can be pressed before entering the statistical display function. In this case, when you enter the statistical display mode the computation will not start until the operator presses "F2/-".
Blocking the screen will not stop any data storage operation in progress.
During the display, the operator can press "ESC" to restore the current screen mask for "SURVEY IN PROGRESS".

2 "STATISTICAL DATA VISUALIZATION" (Impulse parameters)
Select STATISTICAL DATA to display the following mask (example)

```
n n    C O U N             i m p / m n    *
I n s N N N N N N
M a x N N N N N N
T o t N N N N N N
```

- Channel no. (nn)
- Brief description of the parameter (CONTP)
- The instantaneous value (Ist.). Intensity of impulses/minute.
- The maximum dated value* (Max.). Maximum intensity of impulses/minute -> (dd/mm/yy hh:mm:ss)
- The total value* (Tot.) Total from the beginning of the measurement or last “RESET STATISTICS” with automatic clearing at 999.999

A flashing light (*) also indicates the operation of the statistical computation
Press the “right arrow” key and the mask will become:

```
1 0    C O U N t e r                      *
I n s      z z z z z z Z / y y y y y y y
M a x d d / m m / y y    h h : m m : s s
T o t            G G G   h h : m m : s s
```

- The number of acquisitions from the beginning of the measurement (yyyyyyy)
- The number of acquisitions from the last " RESET STATISTICS " (zzzzzzz)
- Date/time in which the greatest intensity occurred (dd/mm/yy hh:mm:ss)

- Time elapsed from the beginning of the measurement or from the last RESET STATISTICS (ddd hh/mm/ss)

3 "STATISTICAL DATA VISUALIZATION" (Logic state parameter)
Select statistical visualization to display the following mask (example)

```
n n    P                                        *
I n s          N N
N r S N N N N N N
N r N N N N N N N
```

- Channel no. (nn)
- Brief description of the parameter
- The instantaneous value (Ist.). YES/NO state measured at the last acquisition.
- The number value of YES (NrS) Number of YES from the beginning of the measurement or from the last RESET STATISTICS
- The number value of NO (NrN). Number of NO from the beginning of the measurement or from the last RESET STATISTICS

A flashing light (*) also indicates the operation of the statistical computation
Press the “right arrow” key and the mask will become:

```
4      P r e s e n c e                          *
I s t      z z z z z z Z / y y y y y y y
N r Y                h h H h h : m m : s s
N r N                h h H h h : m m : s s
```

- The number of acquisitions from the beginning of the measurement (yyyyyyy)
- The number of acquisitions from the last " RESET STATISTICS " (zzzzzzz)
- Sum of the YES times from the beginning of the measurement or from the last RESET STATISTICS
- Sum of the NO times from the beginning of the measurement or from the last RESET STATISTICS

2.9. Air delivery calculation and number of air changes

When anemometric probes are connected to BABUC, it shows and stores (if survey with storage) the followings values :

- Volumetric air delivery (cu.m/sec)
- Mass air delivery (Kg/sec) - ATTENTION : only if a temperature probes is still connected (See: Part 4 – Analytical description: AIR TEMPERATURE PROBES CODES).
- Number of air changes (N/h)

The user should insert the pipe dimensions and form in which he is going to measure air delivery and the room volume in which he is going to measure the number of air changes. A temperature probe is needed if mass air delivery should be calculated; BABUC uses the probe nearest to the anemometer input.
The pipe dimension and room volume parameters are inserted and stored into the SYSTEM-> STANDARD PARAMETERS option. For fast use of the data it is also possible to enter such information into the VISUALIZATION option.

```
  T e m p e r a t u r E
  G r a v i t y
  A t m .   P r e s s U r e
  A l t i t u d e   A S L
  L a t i t u d e
  L o n g i t u d e
  R o o m     v o l u M e
> P i p e     d i m e N s i o n s
  L i g h t   s o u r C e   d i s t .
```

Press IMMIS

```
P i p e     d i m e n . . ( c m )
C I R C U L A R   ( d ) : 0 0 0
R E C T A N G U L A R   :     0 x     0
P I P E   F A C T O R   : 1 . 0 0 0
```

Type the requested information and then press IMMIS. In case an incorrect value is inserted, press IMMIS and the screen will not change without returning to list of STANDARD PARAMETERS.
After inserting the values, carry out a survey. During the measurement, BABUC automatically displays the air delivery and change values that were already calculated. If the pipe geometry has not been set or equal to zero, the instrument does not display the air delivery values or number of air changes.
If the air temperature probe is not present, BABUC shows an ERROR message corresponding to the mass air delivery.

See: Part 4 – Analytical description: Delivery and air changes (Calculation)

2.10. Calculation of the wall thermal conductivity (“K” Factor)

When BABUC is connected to wall-mounted flowmeter probes (BSR240), air temperature and contact temperature probes, it displays and stores (if programmed to do so) a series of wall unitary thermal conductivity values.
BABUC can use one of two types of formulas for the calculation. The regular formula needs more parameters and is therefore more accurate than the reduced formula.

The regular formula (can only be used with BABUC/A)
It makes use of the following probes:
- 1 Internal air temperature probe
- 1 External air temperature probe
(See: Part 4 – Analytical description: AIR TEMPERATURE PROBES CODES).
- 1-2 Temperature probe in contact with internal surface
- 1-2 Temperature probe in contact with external surface
(Select : BST110, 125, 205, 205, 207, 220, 221, 222, 224, 225, 801)
- 1-2 Flowmeter probe (BSR240)
It obtains the following values:
- Heat flow. W/m^2
- Overall thermal conductivity (“K” factor). W/(m^{2}K)
- Internal surface↔internal air thermal conductivity factor (Ki - αi) W/(m^{2}K)
- External surface↔external air thermal conductivity factor (Ke - αe) W/(m^{2}K)
- Internal surface contact temperature °C
- External surface contact temperature °C
- Internal air temperature °C
- External air temperature °C

The reduced formula (usable with either BABUC/M or BABUC/A)
It makes use of the following probes:
- 1 Internal air temperature probe
- 1 External air temperature probe
(See: Part 4 – Analytical description: AIR TEMPERAUTURE PROBES CODES).
- 1-6 Flowmeter probe (BSR240)
It obtains the following values:
- Heat flow. W/m^2
- Overall thermal conductivity (“K” factor). W/(m^{2}K)
- Internal air temperature °C
- External air temperature °C

Before measuring the values for use in the thermal conductivity calculation, the following functions are programmed into BABUC:
- Normal measurement or measurement for calculation of the thermal conductivity
- Use of regular or reduced formula
- Number of heat flow measuring points
- Delta “T” value between internal temperature and external temperature. (can be set from 1 to 20°C)
- Calibration factor for sensor BSR240. (see CALIBRATION FACTOR in Part 4)

From the main menu, select “K Factor measurement”

```
  N o r m a l   S u r V e y
> " K " F a c t O r   S u r v e y
```

```
  S h u t d o w N
  F i l e s
```

Press IMMIS

```
" K " F a c t o R M e A s u r e m e n t
> R e g u l a r   F o R m u l a
  R e d u c e d   F o R m u l a
```

Select type of formula to use

```
" K " F a c t o R   s U r v e y
m e a s u r i n G   p O i n t s :
( T a I n t - T A E x T )   > 1 0 " C
```

- Enter the number (N=) of BSR240 probes which will be connected to the instrument after having set the calibration factors of each sensor. (see Calibration Factor)
- Enter the minimum Delta temperature value (int. temp./ext. temp.) forecast for the measurements. (default 10°C)

Press IMMIS

```
K   F a c t o r   P r O b e   M a p
1 : T A i n t
2 : T A e x t
3 : F L X 1
```

Connect the sensors to BABUC following the instructions supplied with the instrument. Where:
TA int. = internal air temperature probe
TA ext. = external air temperature probe
FLX = flowmeter probe BSR240
Tsint. = internal wall surface temperature probe
Tsext. = external wall surface temperature probe

Press IMMIS

```
> W i t h o u t   s t O r A g e
  W i t h   s t O r a G e
```

The instrument is now set up to take measurements for the thermal conductivity calculation.
To continue, follow the instructions given in points 6, 7 and 8 of this chapter.

See: Part 4 – Analytical description: "K" factor measurement

2.11. Daylight Factor Calculation

When the BSR000 or BSR001 internal luminance probes and the BSR003 or BSR005 external luminance probes are connected, BABUC shows and in case stores (if a survey with storage is in progress), if enabled, the following values:
- LUMINANCE in klux (esterno)
- LUMINANCE in lux (interno)
- Daylight Factor – DaylightFact. in %

DLF Calculation, This enabling is set in SYSTEM -> DLF Calculation

See: Part 4 – Analytical Description DLF Calculation – Daylight Factor

2.12 Calculation of dissatisfied due to Vertical air temperature difference

When the temperature probe BST230 is connected , Babuc shows, and in case stores (if a survey with storage is in progress), the following values:

- Percentage of dissatisfied by floor temperature (PDp)- InsodTePavim
- Floor temperature
- Ankles temperature

Moreover, when in addition to the BST230 an air temperature probe is connected, mounted at 110 cm from the floor, BABUC shows, and in case stores (if a survey with storage is in progress), the following values:

- Percentage of dissatisfied by vertical temperature difference (PDv) – InsodTeVert

See: Part 4 – Analytical description: Calculation percentage of dissatisfied due to vertical temperature difference

2.13 Radiant Asymmetry Calculation and index of dissatisfied due to radiant asymmetry

When connected the Net radiation probe BSR231, and a probe of air temperature, BABUC shows and in case calculates (if a survey with storage is in progress), the following values:

- Environmental air temperature in ° C
- Net Radiation – RadNET
- Radiant asymmetry temperature – TeAsimRADiant
- Percentage of dissatisfied due to radiant asymmetry (PDp – InsodTeAsRad)

For calculating the percentage of dissatisfied for radiant asymmetry, the operator has to indicate to the instrument the axis on which he is doing the measurements:

- Horizontal axis (ceiling-floor)
- Vertical axis (wall-opposite wall)

This information is set in SYSTEM>DISSAT.RAD.ASYMM.

See: Part 4 – Analytical Description: Calculation-Radiant asymmetry – Calculation Dissatisfied due to radiant asymmetry.

2.14. How to print

BABUC can print stored data directly.
Printing can be performed on any serial printer with the following settings:

a) protocol:	Xon-Xoff	d) Stop bits:	1
b) Interface:	RS232 - DCE Interface	e) Parity:	None
c) Data length:	8 bits		

If the Kodak printer **LSI LASTEM** model "BAT100" is used, the following parameters should be set :

1) Emulation:	IBM Proprinter	10) Protocol:	Xon-Xoff
4) Character Set:	IBM Proprinter	11) Parity:	None
5) Character Default:	IBM Proprinter	12) Data length:	8 bits
		13) Bit rate:	9600

5 types of print modes are available:

- Survey indices
- Processed data tabular printouts
- Active parameters on the instrument
- Instantaneous values
- Processed data graphic printouts

After connecting BABUC to the serial input port of the printer using the cable provided (mod.BSH110),

Warning: For printers, do not use cable BSH100 with 9/25 pin adapters

Check that the instrument bit rate corresponds to the printer bit rate (if different, change it using the option "COMMUNICATION->BIT RATE"), and check that the printer Xon-Xoff protocol has been enabled.
Select "PRINTOUTS" from the main menu and set the following:
"SELECT SURVEY " identifying it with the number, sub-number, date/time of start-end.
"SELECT DATA" to be printed.
SELECT SURVEY “start" and "End", i.e. the time range for printing.
Moreover, for the last two printing modes (Tabular and Graphic form) it is possible to select the following:
"PROCESSING TIME", i.e. the time base for statistical processing.

2.15. How to connect BABUC to the PC

BABUC may be connected to a PC using the cable provided (mod.BSH100), connecting it to the RS232 serial line (or RS485 for models equipped with this function only). Depending on software availability, the connection can be controlled by the PC (INFOGAP ADVANCED) or directly by BABUC (INFOGAP BASE). In any case, the operator must switch on BABUC to activate the serial line.
See the INFOGAP ADVANCED manual.
See part 4 ->ASCII TABLE (if the software is INFOGAP BASE).

2.16. Procedure in the event of shut-down

Shut-down is rare but possible and can be diagnosed. It occurs when the instrument does not respond to any commands. If this happens, to reset operation, disconnect the batteries for a few seconds (10 sec.) without feeding it from the mains.
The battery compartment is located at the rear of the instrument and can be opened by unscrewing the screw situated on the right-hand side under the power plug (BABUC/A) or by removing the cover (BABUC/M).

PART 3 - MAIN MENU

Survey

"Survey" is the function by means of which BABUC acquires, displays and stores data with various different logic and procedures. Measurement can be performed with storage or without storage. In both cases the acquired data can be displayed. Measurement without storage is the default so if the operator requires data storage he must “make” the relevant setting.
During the Survey, you can select the options in the "UTILITIES" and "COMMUNICATION" menus.

"K" Factor Survey

The “K Factor survey” is the function that is used to set all the options to perform a survey to calculate the wall or surface thermal conductivity factor. When BABUC is connected to wall-mounted contact flowmeters (BSR240) and air and contact temperature probes, it displays and stores a set of parameters relative to the “K factor”.

Comm.

"*Communication*" is the function that is used to change the communication options between BABUC and PC or printer. The options are the following:
- Transmission speed (see "BIT RATE" in part 4)
- Messages regarding the communication protocol (see "PROTOCOL INFOS" in part 4)
- Protocol ID (See "PROTOCOL ID" in part 4)

Files

"*Files*" signifies the set of data stored during the surveys. The "Files" option enables the operator to obtain certain information on available storage space and to delete unwanted information:
- Storage space available (see "MEMORY AVAILABILITY" in part 4).
- Index of stored surveys (see "SURVEY INDEX" in part 4)
- Deletion of the last stored survey (see "DELETE LAST SURVEY in part 4).
- Deletion of all stored surveys (see "DELETE ALL SURVEYS" in part 4).

Printouts

The "Printouts" menu contains the print options for the document required.
They are:
- printout of the stored Surveys index (see "SURVEY INDEX" in part 4).
- printout of the instantaneous values of a given survey (see"INSTANT VALUE ”printout" in part 4).
- printout in tabular form of the statistical data of a given survey (mean, minimum, maximum, standard deviation) according to the selected time base (see " TABULAR printout" in part 4).
- printout in graphic form of the statistical data of a given survey (mean, minimum, maximum) according to the selected time base (see "GRAPHIC printout” in part 4).
- printout of all the parameters currently in use on the instrument: Transmission speed, multiplication factor, radiometric calibration, acquisition rate, engineering factors, etc. (see "PARAMETERS IN USE printout" in part 4).
- printout in the form of an ASCII table for importing the surveys into a PC (see "ASCII TABLE importing on PC" in part 4). This option can be used with InfoGAP base software.

Utilities

The "*Utilities*" menu consists of the operations controlling the functioning of the instrument that do not directly concern the "Survey". They are the following:
- setting date/time of the system (see "SYSTEM DATE/TIME" in part 4).
- available storage space (see "MEMORY AVAILABILITY" in part 4).
- battery voltage (see "BATTERY VOLTAGE" in part 4).
- error management (see "ERROR MANAGEMENT" in part 4).
- beeper setting (see "BEEPER" in part 4).
- setting keyboard protection (see "KEYBOARD PROTECTION" in part 4).
- setting display automatic switch-off (see "DISPLAY BLANKING" in part 4) (BABUC/A only)
- Serial number version

System

In the "*System*" menu, all settings regarding the connected sensors and memory are executed.
In particular:
- modification of the acquisition, actuation time and engineering parameters. (see "MODIFY PARAM. CODES" in part 4)
- amplifier calibration (for LSI LASTEM engineers only)
- setting of standard parameters for certain tasks (see "STANDARD PARAMETERS" in part 4)
- setting calibration factors for radiometer and flowmeter calibration (see "CALIBRATION FACTOR" in part 4)
- selection of the use of differential barometers (see "USING DIFFERENTIAL PRESSURE SENSORS" in part 4)
- setting transfer time of non-volatile memory (see "STATIC MEMORY TRANSFER" in part 4)
- setting the acquisition rate multiplication factor (see "M FACTOR" in part 4).
- select the temperature to use for calculating the DR index - Draught Rate (see CALCULATION – DR INDICE in part 4)
- setting the calculation index Percentage of dissatisfied by radiant asymmetry see CALCULATION – INDEX OF DISSATISFIED DUE TO RADIANT ASYMM. In part 4)
- Deciding whether or not to use the ± 4 Vdc channel (see USE +-4 VOLT CHANNEL in part 4)
- Deciding whether or not to store the battery values (see BATTERY STORAGE in part 4)

PART 4 - ANALYTICAL DESCRIPTION

System

ACQUISITION RATES (of sensors)

Each class of sensors or signals has an acquisition rate that can be set separately, with a range from 1 second to 24 hours. **LSI LASTEM**'s factory set acquisition rates are, on average, the most suitable for the management of each corresponding parameter. The rates can be changed using the path SYSTEM -> MOD.PARAM. S/probes -> Code; resulting changes are permanent, until the next time the rate is modified. In the survey set-up procedure, in the "Channels in use" list, it is possible to display (but not modify) the rate of the sensors connected at the time. On the contrary, during the set-up stage, the operator can change all acquisition rates by multiplying them by a collective factor (from 1 to 99) which can be set as a default value using the M Factor. The acquisition rate of the channel dedicated to the battery is fixed and cannot be changed with the M Factor.

Example: The operator wishes to carry out an 8-hour Survey acquiring two different parameters, with an acquisition rate of 10 seconds for both. Assuming that BABUC indicates that, according to its calculations, available storage space will be filled in 4 hours. In accordance with the information requirements of the Survey, the operator has three courses of action:

- *Equal sampling spread over the two values, setting value 2 for the "M" factor defining the multiplication coefficient for acquisition rates.*
- *Assigning a rate, slower than the other rate used, to the less important parameters, by means of the MODIFY PARAM. s/Codes option.*
- *Create memory space by deleting a part of the resident data after having generated a hard copy (printout) or backing up the files by uploading them to a PC.*

The instrument takes one second to acquire data at each input, therefore the minimum rate that can be assigned to each sensor is the number of sensors connected expressed in seconds. This minimum rate is automatically selected by BABUC for Surveys without storage.

Example: The fastest possible acquisition rate is 1 second if only one sensor is connected, 2 seconds for two sensors, ten seconds for 10 sensors, and so on.

See also: "MODIFY PARAM. S/CODES, VISUALIZATION, M" FACTOR

System

ACTUATION RATE (of sensors)

In some cases, acquisition by a sensor may make it necessary to feed power somewhat ahead of acquisition. The duration of this advance interval is one of the parameters typical of each class of sensors and signals. Actuation power is 9 V unstabilized, maximum delivery of 0.2 Amp each sensor, total maximum simultaneous: 0.6 Amp

Example: Assume that the psychrometric sensor is programmed to acquire data every 10 minutes, and that its actuation time is 1 minute. This means that 1 minute before the tenth minute elapses, the fan motor is turned on and stays on until the sensor has acquired the relevant datum. If the operator sets an "actuation" time that is longer than the "ACQUISITION RATE", BABUC will drive the motors continuously.

See also: "MODIFY PARAM. S/CODES, ACQUISITION RATES of sensors"

Rilievo

AIR TEMPERATURE PROBE CODES

For some calculations, the instrument requires the presence of one or more air temperature probes (i.e. the K factor calculation or the Air speed calculation with the Pitot tube, DR index calculation, etc.
The following list quotes the commercial codes of the **LSI LASTEM** probes that can be used in those calcultaions where an air temperature probe is required:

BST101, BST102, BST104, BST105, BST107, BST116, BST118, BST120, BST122, BST127, BST201, BST216, BST218, BST301, BSU102, BSU104, BSU106, BST101, BST102, BST104, BST105, BST107, BST116, BST118, BST120, BST122, BST127, BST201, BST216, BST218, BST301, BSU102, BSU104, BSU106, BSU400, BSU401, BSU402, BSU403, BSU402.1, BSU403.1, BSU431.

System

BATTERY STORAGE

The battery voltage value can be stored to evaluate the efficiency of the charge.
This option can be selected. The voltage values are stored in channel no. 12 (BABUC/A), channel 7 (BABUC/M) and can be printed or transferred to a PC like any other logic channel.

Utilities

BATTERY VOLTAGE

By means of the "BATTERY VOLTAGE" option, BABUC will report the charge level and percentage of its internal battery. The values are updated on the data visualization masks in relation to the acquisition rate of the “Battery” channel (Sub-code no. 111). The battery voltage can be stored by using the option SYSTEM-> BATTERY STORAGE.
Under normal conditions battery power must be within the following ranges:
Instrument fitted with rechargeable batteries: 6 to 9 Volt.
Instrument fitted with alkaline batteries: 5.8 - 7 Volt.
The battery compartment is located at the rear of the instrument and can be opened by loosening the screw located on the right-hand side of the power plug (BABUC/A) or by removing the compartment (BABUC/M).
Protection against reduced voltage and/or power failure during a Survey is based on the following logic:

1) If the battery voltage drops, for more than three acquisitions, below:
   - Instruments with rechargeable batteries: 6.5 Volt, BABUC stops the survey; the survey is restarted automatically using a higher sub-Survey number when voltage returns to above 7.5 Volt
   - Instruments with alkaline batteries: 5.8 Volt, BABUC stops the survey; the survey will be restarted automatically using a new sub-Survey number when voltage returns above 7 Volt.
2) If, in the meantime, voltage has dropped still further to below:
   - Instruments with rechargeable batteries: 6 Volt, BABUC switches off and will automatically start a new survey when voltage returns to above 7.5 Volt.
   - Instruments with alkaline batteries: 5.3 Volt, BABUC/M switches off permanently and cannot restart automatically. BABUC/A is able to switch on automatically when the voltage returns to above 6.5 Volt, in which case it will start a new survey.

If battery voltage falls below the factory thresholds, the instruments will generate an error message that must be removed with the "Error management" procedure.

Attention : BABUC/A is fitted with rechargeable batteries (standard); the batteries are recharged by connecting the instrument to the mains by using the power pack (model BSC010). BABUC/M is fitted with non-rechargeable batteries (standard); when the voltage is insufficient the batteries must be replaced with new ones (Duracell MN1604 6LR61 9 Volt).

Utilities

BEEPER

The "Beep" indicating each valid keystroke on the BABUC keyboard can be enabled or disabled with the "BEEPER" option.

See also: "VISUALIZATION"

Comm.

BIT RATE

During communication between BABUC and PC, or BABUC and printer, the transmission speed between the two systems must be identical, i.e. the same bit rate (1200, 2400, 4800, 9600, 19200 bps). The bit rate is set on BABUC by using the "Bit rate" option.

Survey

CALCULATION - AIR DELIVERY & NUMBER OF AIR CHANGES

The air delivery is calculated as follows :

Volumetric air delivery

(1) $Pv = Ac * Va$

Pv:	Volumetric air delivery in m^3/s
Ac:	Pipe section in m^2
Va:	Air speed in m/s

Mass air delivery

(2) $Pm = \rho * Ac * Va$

Pm:	Mass air delivery in Kg/s
ρ:	Air Density in K * Atmospheric pressure (atm)/Air T(K)
K:	Dimensional coefficient valid for air = 353.1

Number of air changes

(3) $Nr = Va * Ab * 3600 / Cv$

Nr:	Changes in Number/hour
Cv:	Room Volume in m^3
Ab:	Pipe section in m^2

Since the pipe and union speed cross section is often complex, the Ashrae Handbook reports a "Pipe Factor", i.e. the ratio between the average instantaneous air speed and maximum air speed measured in the center of the pipe. This Pipe factor is 2/3 and 1/2 for, respectively, rectangular and circular rigid pipes. The Pipe Factor can be programmed on BABUC (from >0 to 1). It is particularly useful in fixed installations where it is possible to correlate the average speed through the pipe with the speed measured in the measurement point.

BABUC uses the temperature value from the air temperature probe connected into the nearest input of the anemometer probe to calculate the mass air delivery.

(see: Part 4 – Analytical display : AIR TEMPERATURE PROBES CODES.)

Survey

CALCULATION - PERCENTAGE OF DISSATISFIED TO VERTICAL AIR TEMPERATURE DIFFERENCE

In the version of 29/11/2000, the standard ISO7730 introduces, as localized factor of discomfort, an index which takes into consideration the vertical temperature gradients:

It considers that, an high vertical gradient between temperature measured at 100 cm (ta, 110) (by a temeperature probe), and at 10 cm (ta,10) from the floor (by the BST230 probe), creates a localized discomfort especially when the temperature near the floor is colder. The index (PDv) defines the percentage of dissatisfied for this reason and it is calculated considering the pic.2 of paragraph 5.2 of the ISO7730.

Survey

CALCULATION – PERCENTAGE OF DISSATISFIED TO WARM OR COOL FLOOR

In the version of 29/11/2000, the ISO 7730 introduces, as localized factor of discomfort, the asymmetry of the radiant temperature, an index which takes into consideration the floor temperature.

It considers that, the occupants of an environment can have a localized discomfort if the floor temperature (measured by the probe BST230) , is too warm or too cold. The index (PDp) defines the percentage of dissatisfied for this reason and it is calculated considering picture 3 of the pharagraph 5.3 of the ISO7730.

Survey

CALCULATION – PERCENTAGE OF DISSATISFIED TO RADIANT ASYMMETRY

In the version of 29/11/2000, the ISO7730 introduces, as localized factor of discomfort, the asymmetry of the radiant temperature, by the index:

Percentage of dissatisfied due to radiant asymmetry (cap. 5.4 of the standard)
The index is calculated with different curves according to wether the asymmetry is measured on the axis “floor-ceiling” (“red sign” of the probe BSR231 towards the ceiling) or on the axis “wall-opposite wall” (“red sign” of the probe BSR231 towards the wall). Moreover different curves are used according to wether the ceiling or the wall have an asymmetric radiant temperature colder or warmer.
The operator has to program the necessary axis in the menu “SYSTEM -> % Dissat.Rad.Asym.-> “Choose the axis to use in calculation”-> “Ceiling-floor” or “Wall-opposite wall”.
According to the above, the program will use, in the calculation, the right curves.
It is advisable, during the measuerements to take note of the analysed axis, because this information is not indicated in the measures made.

Survey

CALCULATION - DR “Draught rate”

When the instrument is connected to the following probes:

- Air Speed and turbulence intensity BSV105
- Air Temperature

It visualizes and memorizes (during a survey with storage) the DR index – Air currents risk, which is the subject of the UNI EN ISO 7730 September 1997.

The DR is calculated with the following expression:

DR= (34.0-ta) * pow((va-0.05),0.62) * (0.37*va*TU+3.14).
Where :
Ta is air temperature
Va is air speed
TU is Turbulence intensity.
(see: Part 4 – Analytical display : AIR TEMPERATURE PROBES CODES.)

System

CONFIGURATION OF THE DR CALCULATION

This option (“SYSTEM -> Config DR calculation”), determines the reference temperature to be used in calculating the DR index. The temperature can be manually added (value added in SYSTEM -> STANDARD QUANTITIES -> TEMPERATURE), or it can be directly acquired by a temperature probe connected to the instrument

If the operator connects two temperature probes, BABUC will consider the measure acquired with the probe put on the input preceding the one where the turbulence probe is connected. If the operator has two turbulence probes, BABUC will use always the same temperature.

(see: Part 4 – Analytical display : AIR TEMPERATURE PROBES CODES.)

Rilievo

CALCULATION – RADIANT ASYMMETRY

[1] Defintion and formulas according to the UNI-EN27726, official version of the EN27726 (ed. 1993).
The radiant asymmetry probe BSR231, through the measure of its temperature and of the net radiation, allows the calculation of the radiant temperature asymmetry Δt_{pr} along a space direction, and of the **Percentage of dissatisfied by radiant asymmetry** (see RADIANT ASYMMETRY DISSATISFIED PERCENTAGE CALCULATION). The air temperature can be measured from one of the probes listed in “ **Part 4 – Analytical display : AIR TEMPERATURE PROBES CODES.)**”.
Along the survey the instrument calculates, visualizes and stores (if programmed) the following quantities:

TARAD = Δt_{pr} = Radiant asymmetry temperature in °C (default)
INTAR = dissatisfied by radiant temperature in % see ISO-CD 7730 (default)

The formulas used for the calculations are the following:

a) TARAD = radiant asymmetry temperature (Δt_{pr}): difference between plain radiant temperature of two faces of a little plain element (along a space direction) ([1] § C.1.2..(17));

$$\Delta t_{pr} = \frac{RNETT}{4 \cdot \sigma \cdot (t_n + 273.15)^3}$$

Where:

RNETT = net radiation in W/m²

σ is the constant of Stefan-Boltzman $\left(5.67 * 10^{-8} \left[\frac{W}{m^2 * K^4}\right]\right)$

tn =Plain radiant temperature (t_{pr}): it is the uniform temperature of a cavity where the radiation, influencing a face of a little plain element, is the same present in a non uniform real environment. The $\mathbf{t_n}$ coincides, as a first approximation, with the T temperature of the sensitive element. To improve the approximation, considering the thermal conduction phenomena in the air, in Babuc an expression is used, considering the air temperature. In this way you obtain a tn measure nearer to the correct one (TPRM) . The instrument calculates TPRM by a formula obtained from the mean radiant temperature (see reference [1] appendix B), using the globethermoeter adding the values experimentally obtained

$$tn = \left[(tc + 273{,}15)^4 + 0.4 * 10^8 * |tc - ta|^{1/4} * (tc - ta)\right]^{1/4} - 273{,}15 + (tc - ta) * |tc - ta|^{0.57}$$

Where:

Ta = environmental air temperature in °C

Tc = temperature of the radiometer black element in °C

The tn is described in UNI-EN27726 at § C.1.2 see reference [1]. Moreover, using the SETUP module of the InfoGAP program, it is possible to set the calculation of the following quantities:

TPRM = $\mathbf{t_n}$ = mean plain radiant temperature
Tpr1 = wall plain radiant temperature 1 in °C
Tpr2 = wall plain radiant temperature 2 in °C

Survey

CALCULATION – WBGT "WET BULB GLOBE TEMPERATURE"

When BABUC is connected to the following probes :
- Globothermometric probe BST131
- Wet bulb temperature with natural ventilation BSU121
- Dry air temperature (BST or BSU102), only if outdoor WBGT is required

It calculates, displays, and stores (if a survey with storage is carried out) the WBGT thermal stress index in its two versions: indoor WBGT and outdoor WBGT.
If BABUC is connected to the following probes :
- Globothermometric probe BST131
- Forced ventilation wet bulb probe BSU121

It calculates, displays, and stores (if a survey with storage is carried out) the WBGT thermal stress index only in the indoor WBGT version.

The WBGT index is mentioned in the ISO7243 (Hot environments - Estimation of the heat stress on working man, based on the WBGT-index). It can be used in case of hot environments in order to evaluate the thermal stress.

The Indoor WBGT formula is: **WBGT = 0.7 Tnw + 0.3 Tg (°C)**

while the Outdoor WBGT formula is: **WBGT = 0.7 Tnw + 0.2 Tg + 0.1 Ta (°C)**

where Ta is the air temperature, Tnw and Tg are the natural ventilation wet temperature measured by BSU121 and the globotemperature measured by BST131

Survey

CALCULATION - UVA DENSITY

When connected to the following probe: Combined probe Lux/UVA (BSR107)
BABUC calculates, displays and stores (if a survey with storage is performed) the derived parameter “UVA Density”. This is the density of the UVA radiation contained in the visible luminous flow unit. The ultraviolet radiation emission (UV-A), contained to a greater extent in natural light and in light emitted by fluorescent and halide vapor lamps, may in fact interact with photosensitive and/ or thermosensitive materials, accellerating numerous chemical reactions which alter and degrade objects.
The parameter is calculated using the following formula:

UVA Density = $\mu W*m^{-2}$ / $lm*m^{-2}$ = $\mu W/lm$ (lm = Lumen = lux/m^2)

Rilievo

CALCULATION – DLF- DAYLIGHT FACTOR

When BABUC is connected to the following probes:
Luxmetric probe for internal (BSR000, BSR001)
Luxmetric probe for external (BSR003, BSR005)

If it is enabled the calculation SYSTEM -> DLF calculation, it calcualtes, shows and stores (if a survey with storage is performed), the derivated quantity “Daylight Factor”
This factor, initially appeared on the Circular of the Ministry of Public Services n. 3151 dated 22/05/1967, and then confirmed by the L.D. issued by the Ministry of Health on 05/07/1975 regarding the sanitary requirements of the living rooms; according to the same circular it can be defined by the following calculation formula:

$$\eta = \frac{E}{E_0}$$ **Ratio in % =** η *** 100**

Essential condition to perform a measure is, indeed, the presence of a sky uniformously covered because, in general, the limits indicated from the law are always referred to that condition. The survey operation implies, possibly, the use of two luxmetres, so to measure the external luminance, Eo, contemporarily to the internal one, E. The value of the luminance E of the environment internal point, is made up of three components: the contribution due to the portion of sky seen through the window, the contribution due to the multiple reflections happening inside the environment. The global daylight factor can be, thus expressed as ratio between the internal environment luminance and the external environment luminance, Eo. The ratio is then multiplied
per 100 to transform it in % .

Rilievo

CALCULATION: HEAT AND HEAT STRESS INDEX

When the instrument is connected to the following probes:
- Relative humidity (RH %) BST101, BST102, BST104, BST105, BST107, BST116, BST118, BST120, BST122, BST127, BST201, BST216, BST218, BST301, BSU102, BSU104, BSU106, BSU400, BSU401, BSU402, BSU403, BSU402.1, BSU403.1, BSU431.
- Air temperature (Ta °C)

it calculates, displays and stores (during a survey with storage), the derived quantities:
- Heat Index (°C)
- Heat stress index

The heat sensation is mainly due to a series of factors, among which, the air temperature and the relative humidity. In sultry weather conditions, indeed, the sweat produced by the organism to lower the body temperature cannot evaporate in the sorrounding environment because already saturated. In these conditions, and without the cooling contribution of the sweat, the body temperature tends to get higher with the possibility of heat strokes in case certain extreme values are overloaded. So, an heat index has been created to underline the temperature felt by the body instead of the real one. For example, with a temperature of “only” 29 °C and a humidity level of 70% the human body feels 34°C. It is possible to note how, at any temperature with 90% of humidity, the risks for an organism are very high, and go from a heavy fatigue with breath difficulties to a possible heat stroke or sunstroke. In case of low humidity, instead, the sensation felt by the organism, can also be lower than the real temperature. For example, with a humidty level of only 10%, 38°C will be perceived as “only” 36°C.

The heat index can be calculated with the following formula:
Heat index =-42.379 + 2.04901523xTf + 10.14333127xRH - 0.22475541* Tf *RH – 0,00683783*Tf^2 – 0,05481717*RH^2 + 0,00122874*Tf^2*RH + 0.00085282*Tf*RH^2 – 0,00000199*Tf^2*RH^ Fahrenheit degrees.

Tf =Air temperature in Fahrenheit degrees
RH =relative humidity
Formula from Celsius to Fahrenheit degrees and viceversa
Ta = 5/9*(Tf-32) Tf = (9/5)*Ta+32

With the heat index calculation, the Heat stress index can be calculated with the following table:

Heat index	Discomfort description on BABUC	Exposition description
Less than 27 degrees	0 = null	No risks
Between 27 and 31 degrees	1 = light	Possibile fatigue, heat cramps
Between 32 and 39 degrees	2 = medium	Strong fatigue, breath difficulties
Between 40 and 54 degrees	3 = strong	Possibile heat stroke, sunstroke
More than 54 degrees	4 = extreme	Heat stroke highly probable

CALCULATION – UV INDEX AND EXPOSITION LEVEL

Babuc, when connected to the UV-A (W/m^2) and UV-B (W/m^2) broad band radiometer, calibrated and programmed (Reference INTERSUN-GLOBAL UV project UV-index, ANNEX C)calculates, displays and stores (during a survey with storage) the derived quantities:

- UV Index
- UV Exposition level

The UV index expresses the intensity of the solar ultraviolet radiation. This index is internationally adopted so to transmit to the population information about the possible health damages (skin and eyes), in case certain levels are surpassed.

The UV index expresses the dangerousness of solar radiation during the solar noon (maximum elevation of the sun over the horizon), and coincides, in clear days, with the maximum level of ultraviolet radiation.
The UV index can assume values from 0 to 12; increasing values of the UV index express increasing risks to the solar exposure.
The values quoted in the below tables are about the relative times of exposition suggested to avoid damages; they have to be considered indicative, being, indeed, referred to skin exposed to the sun for the first time during the season, unprotected by creams and that still do not have developped a certain natural resistance to the UV radiation; for already tanned skins, these times can be doubled.

The skin types can be so summarized:

Skin type	Gets tanned	Burns	Hair	Eyes
I	never	always	red	blue
II	sometimes	sometimes	blondes	blue/green
III	always	seldom	brown	brown
IV	always	never	black	brown

Level of suggested exposition referred to people with sikn type I and II

UV Index	Uv level of exposition	Limits of exposition
0-2	0 = low	> 60 minutes
3-5	1 = light	30-60 minutes
6-7	2 = high	30 minutes
8-10	3 = high++	20 mminutes
> 11	4 = extreme	<15 minutes

Survey

CALCULATION - LUMINOUS INTENSITY

When connected to the following probe:

- Luxmetric probe (BSR001, BSR003, BSR005)

BABUC calculates, displays and stores (if a survey with storage is performed) the derived parameter "Luminous intensity". It indicates the luminous flux of a source in a specific direction, per unit of solid angle, expressed in candles (cd = lumen/steradian).
It is calculated using the following formula:

Luminous intensity = lux*d^2 / sterad (cd)

sterad = 1 (steradian)
d = distance of light source. Inserted in SYSTEM -> STANDARD PARAMETERS -> DISTANCE TO LIGHT SOURCE = 0 m (default). If d=0 the parameter is not calculated, and therefore is not displayed or stored.

Files

DELETE ALL SURVEYS

BABUC is equipped with an EEPROM static memory which retains its data even when the instrument is switched off. Survey files can be deleted only on request from the operator using the "Delete all Surveys" function. The operation is protected with a "confirm" prompt.
The full storage space of the static memory will be restored after deletion of all surveys.

See also: "DELETE LAST SURVEY"

Files

DELETE LAST SURVEY

The last stored survey can be deleted by using the "Delete last survey" function. "Last survey" means also the last sub-Survey. All stored Surveys can be deleted by this function.
The operation is executed after the request is confirmed. Deletion restores the space in the static memory that was previously occupied by the Survey in question.

See also: "DELETE ALL SURVEYS

Utilities

DISPLAY BLANKING (BABUC/A only)

In extensive surveys, if the instrument is battery powered it may be useful to save power by switching off the display. This in no way affects the functions of BABUC. To switch on the video again, press any key (except ON). To set the automatic switch-off time for the display (if no one is using the keyboard), the operator must input the "Automatic display blanking" option and set the time in minutes. To disable this function, set the time to "00".

Utilities

DISPLAY SELF SWITCHING OFF (only BABUC/A)

In long surveys, if the instrument is battery fed, it can be useful to save energy switching the display off. This does not affect the BABUC functions. To switch the display on again, any key of the keyboard can be pressed (except ON).To set the time after which, if nobody works on the keyboard, the display automatically switches off, the operator has to enter in the option “Display self switching off” and set the time in minutes. To disactivate this option set the time “00”.

Survey

END OF SURVEY

A Survey may have programmed or unlimited duration. In the first case, the message "Survey executed" will appear upon completion of programmed measurement. Press "ESC" and end the measurement using the "End Survey" option, confirming your selection. In the second case, the operator must stop measurement using the "End of Survey "option and confirming the selection.

If the operator wishes to start a new sub-Survey, rather than the "End Survey" command, he should use the "New sub-Survey" option.

See also : "NEW SUB-SURVEY, NUMBER OF SURVEY/SUB-SURVEY

System

ENGINEERING PARAMETERS

This function is used for the linear conversion of output data values.

Non-logic state engineering sub codes
The operator wishes to display and store a 0/300 mV signal signifying -20..+100.
By finding the suitable code in the "Operating Codes" table, he will modify the parameters of the corresponding sub-code, using "SYSTEM -> MODIFY PARAMETERS" as follows:
Example:
Parameter 1: lower limit for input signal (0)
Parameter 2: upper limit for input signal (300)
Parameter 3: lower limit for engineered data at output (-20)
Parameter 4: upper limit for engineered data at output (100)
Note: the symbol "-" (negative) is set by using the "A" key in the first box of the line.
The decimal point is set using the "OFF END" key

Modify the limits of the state or presence sub-codes (73, 78, 79, 80)
The operator can program the interval limits of the logic state signal (max. amplitude 0+300 mV) and set the threshold above and below which it switches itself.
Example
STATE OFF : + 00000.000 (it accepts a value from 0 to 150 and displays NO on the screen)
STATE ON : + 00300.000 (it accepts a value from 150 to 300 and displays YES on the screen)
THRESHOLD : + 00150.000

See also: "MODIFY PARAM. S/CODES, PART 7"

Survey

EXECUTION

The data acquisition stage with storage is started by using the "EXECUTION" option.
BABUC will respond in accordance with the values selected in the "SET-UP" option.
Remember that if "EXECUTION" is activated without going through "SET-UP", it is not possible to check if memory space is adequate. When available memory space is exhausted, BABUC will display and record an error message that must be recognized and removed by means of the function: UTILITY ->ERROR MANAGEMENT->DISPLAY->DELETE, in which one or more memory-resident surveys must be erased. If the Survey is programmed for a delayed start, BABUC will wait for the starting date/time, displaying the message "Survey Started". The instrument will not acquire data in this state but awaits the programmed time before starting acquisition.

Example
- A Survey is defined at 17.00 hours and is due to start at 24.00 hours. BABUC will remain in stand-by for seven hours displaying the message "Survey activated". At 24.00 hours measuring will commence and the message "Survey in progress" will be displayed.
- Survey No. 016/001 is set and is due to start at 12.00 hours on 21-05-1992 for a duration of 3 hours. The Survey duly starts at 12.00 on 21-05-92, and is deliberately interrupted at 13.00 hours. If it is restarted at 14.00 hours, the new Survey will be no. 017/001, starting date/time 14.00 hours on 21-05-92, and end time 17.00 hours.

See also: "NUMBER OF SURVEY/SUB-SURVEY, SURVEY START-DURATION, ERROR MANAGEMENT, DELETE LAST SURVEY, DELETE ALL SURVEYS"

Utilities

ERROR MANAGEMENT

While operating, BABUC can indicate any problems by displaying the flashing message "ERROR". To display the type of problem concerned, open the "ERROR MANAGEMENT" option and select "DISPLAY". The operator can eliminate the error message, but not the cause of the problem, by selecting the "ELIMINATE" option. At this point, the operator should eliminate the cause of the problem and then cancel the error message in UTILITIES-ERROR MANAGEMENT-DELETE.
See part 5 "Error Messages" for the meaning and solution of all possible errors.

Example
If BABUC, while measuring, indicates that battery voltage is inadequate, the operator must power the instrument from the mains. This operation will increase voltage to the correct level, but the low battery message will remain stored until the operator eliminates it with the "Eliminate" option. Even if it is switched off, BABUC will continue to store the error message until it is eliminated.

System

CALIBRATION FACTOR

Many radiometric sensors have a non-standard output. BABUC allows the operator to assign a calibration coefficient that can be determined for up to 10 radiometers.
The operator must “initialize” each radiometer being used with a number from 1 to 10 and match that number with its output in mV/Watt/m² (shown on the radiometer's calibration certificate).
During the "SET-UP" operation, when requested by BABUC, the operator must insert the identification number of the radiometer used, in the defined input.

Example
The operator wishes to connect a non-amplified radiometer.
The calibration certificate indicates that the radiometer output rating is 0.013 mV/Watt/m².
The operator must:
- define the radiometer in question with number 01.
- input 01 in the "CALIBRATION FACTOR" option and press IMMIS.
- input 0.013333 and press "IMMIS" (the decimal point is generated with the “OFF END” key)
During the "SET-UP" stage, the operator connects the radiometer in any of BABUC's "non-dedicated" inputs (e.g. no. 3). BABUC will ask which radiometer is connected to input no. 3, the operator will set no.01.

Printouts

GRAPHIC PRINTOUTS

Information available in tabular form can also be printed in graphic form (with the exception of standard deviation). The graph bar is split into three areas indicating the minimum, mean and maximum value of each process. Putting as “Elaboration Time” the value 00:00:00 BABUC will print a single bar corresponding to the whole survey

See also: “TABULAR PRINTOUTS”

Printouts

INSTANTANEOUS VALUES (printout)

First connect BABUC to the printer checking the two systems for compatibility (type, speed, protocol), then access the main menu and shift the cursor to the "Printouts" menu, selecting print option "Instantaneous values".

- Using the up and down arrows, select the Survey
- Select the parameters
- Select date/time for start and end of period. Complete or partial Surveys may be selected.

BABUC will print all the instantaneous values of the Survey file selected.

See also: "TABULAR PRINTOUTS, ACQUISITION RATE"

Survey

INTERNAL TEMPERATURE

When connected to a “thermocouple” type of temperature probe, BABUC displays its internal temperature in the visualization masks.
In fact, there is a temperature sensor (Ni100) inside BABUC which is used for thermocouple probes for cold joint compensation.
The internal temperature value is controlled like any other measured parameter and thus can be stored when a survey is performed with storage

Utilities

KEYBOARD PROTECTION

A facility is provided for protecting the instrument against tampering by unauthorized persons during surveys: a password is input to disable the keyboard without, however, blocking the measurement. To carry out this operation, select the "Keyboard protection" option and input a number. This number must be entered twice before BABUC will accept it. The display will show the message "KEYBOARD PROTECTED WITH PASSWORD..." the keyboard will remain locked in this way until operator keys-in the previously entered password, when prompt "INPUT PASSWORD" appears. If the operator forgets the password, he will have to remove the batteries to reactivate the instrument.

"K" Factor survey

“K” FACTOR MEASUREMENT

When BABUC is connected to a known set of sensors, it can measure the overall thermal conductivity (“K” factor) of either walls or materials. This parameter is used in the construction industry to check the heat insulation of buildings and surfaces in general. It makes this by measuring the amount of heat flowing (heat loss) from the inside to the outside of a room. BABUC makes use of formulas which take into account the surface temperatures of the walls (internal and external surfaces) and the air temperature (internal and external). The instrument can display and store all the measured values. The “K” factor can be calculated by choosing one of two different formulas: a reduced formula and a regular formula. The reduced formula, though slightly less accurate, allows heat flow (Φ) measurements to be taken at several points. It also allows BABUC/ M measurements to be taken since the number of inputs available on this model is insufficient to cover the needs of the regular formula sensors. The reduced formula is only used in the case of markedly stable conditions that the operator must verify (very high int./ext. air temperature differences, stable temperatures). Depending on which BABUC model is used, it is also possible to measure heat flows (Φ)at several points on the same wall. Making full use of all the available inputs, the measuring potential of the various BABUC models thus becomes:

Model	Formula	Max No. of Φ points
M	Reduced	2
	Regular	not possible
A	Reduced	6
	Regular	2

The regular formula makes use of the following probes:
- 1 Internal air temperature probe
- - 1 External air temperature probe

- 1-2 Internal surface contact temperature probe
- 1-2 External surface contact temperature probes
- 1-2 Flowmeter probes (BSR240)

The reduced formula makes use of the following probes:
- 1 Internal air temperature probe
- 1 External air temperature probe
- 1-6 Flowmeter probes (BSR240)

The positions in the inputs of the sensors involved in the calculation are fixed and can be described as follows:

1-Instrument set-up for “regular formula” (BABUC/A only):

Inputs:	1	2	3	4	5	6	7	8
Sensors:	Tai	tae	Φ_1	tsi_1	Tse_1	Φ_2	tsi_2	tse_2

2-Instrument set-up for “reduced formula”:

Inputs:	1	2	3	4	5	6	7	8
Sensors:	Tai	tae	Φ_1	Φ_2	Φ_3	Φ_4	Φ_5	Φ_6

The necessary inputs are used according to the number of measurement points defined, while the remainder can be used for the BABUC normal measurement logic.
The absence of sensors connected to the inputs required by the formula or the presence of non-programmed sensors at these inputs means that the calculations cannot be executed.

Calculation formulas

a) Regular formula:

$$K_{glob} = \frac{1}{\frac{1}{|Ki|} + \frac{1}{|Ke|} + \frac{1}{|Kp|}}$$

b) Reduced formula:

$$K_{glob} = \frac{|\Phi|}{|tae - tai|}$$

K_{glob}: Overall thermal conductivity factor from one fluid (air) to another through the wall.

$$\text{Ki: Internal surface}\leftrightarrow\text{internal air thermal conductivity factor} = \frac{|\Phi|}{|tai-tsi|}\ W/(m^2K)$$

$$\text{Ke: external surface}\leftrightarrow\text{external air thermal conductivity factor} = \frac{|\Phi|}{tae-tse}\ W/(m^2K)$$

$$\text{Kp: Thermal conductivity factor of wall material} = \frac{|\Phi|}{|tsi-tse|}\ W/(m^2K)$$

Φ: Heat flow through the wall (Wm^{-2})
tai: Internal air temperature (°C) tae: External air temperature (°C)
tsi: Internal wall surface temperature (°C) tse: External wall surface temperature (°C)

Measurement methods (Refer to standard UNI 7357)
Depending on the needs for the actual measurement type, all the data acquisition rates for stored values can be set at 10 minutes. This appears to be the ideal compromise between memory used and density of data. A typical measurement for 1 point for the regular formula (5 primary values + 4 derived = 9) for a period of 72 hours contains approximately 4000 data items, while for 2 points for the reduced formula (4 primary values + 8 derived = 12) it contains approximately 5200. The latter figure represents the capacity of the BABUC/M model.
The general recommendation is to perform the measurement during the winter months only, with an internal and external temperature difference of at least 10...15°C. The procedure is as follows:

1 Position the flow sensor on the internal surface as near as possible to the center of gravity of the walled area at a height of approximately 1.5 meters from the floor and far away from any heat source. The sensor is fixed to the wall by a heat conducting compound.

2 The two surface contact temperature sensors are fixed to the internal and external walls at the same position on the two faces and as close as is reasonably possible to the heat flow sensor (2-3 cm). The use of a heat conducting compound is also recommended in this case.
3 The two air temperature sensors are positioned no less than two centimeters from the wall at a height of 1.5 meters from the floor.
4 During the test, the room heating system must be operational and kept as constant as possible in order to produce a temperature difference between the inside and outside of at least 10..15°C. Doors and windows must be kept closed. The measurements must be taken over a period of not less than 72 consecutive hours after the system has reached its steady-state operating conditions.
5 At the end of the test period, the values considered are the mean of all those measured.

Files

Utilities

MEMORY AVAILABILITY

The storage space in the BABUC memory (EEPROM) is indicated in free bytes (b.) out of total bytes and as a percentage. BABUC/A is provided with a standard memory capacity sufficient for 20,000 samples (64K), 50,000 samples (128K) and 110,000 samples (256K), whereas BABUC/M has a memory capacity for 5,000 samples (32K). Each Kbyte of memory consists of 1024 bytes. BABUC uses approximately 20 Kbytes for its operating program. BABUC is capable of storing every "sample", (every individual acquisition), in 3 different types of facilities: Char, Word, Float.

Type of storage	No. of bytes	Measuring range	Decimals
Char	1	0...253	without decimals
Word	2	-32,768..+32,765	fixed point
Float	4	$\pm 10^{38}$	floating point

Each sensor can have an independent type of storage. "Word" is the default setting for each channel and can be modified with the INFOGAP ADVANCED SETUP module to increase or decrease the number of samples that can be stored in the memory, or to memorize data with greater or lesser resolution.

Example : If the user wishes to store temperatures greater than 327°C with a Pt100 probe you must set the memory type for the sub-code of that particular sensor to "Float". In fact, up to 327.65°C can be stored in the "Word" mode but beyond this temperature you will have to change to the Floating point mode and you will lose the last decimal place.

This modification is performed on the PC using INFOGAP ADVANCED VERSION software and is 3333 is in progress; the decrease in bytes can be seen in real time by using the option UTILITY -> MEMORY AVAILABILITY.

System

“M” FACTOR

“M” Factor is the “Default” multiplication number of all acquisition rates active in the "Set acquisition rates" option in the “Set-up” procedure. During the "Set-up" stage the operator can always multiply the acquisition times by other values of “M”. The acquisition rate of the channel dedicated to the battery is set and cannot be changed with the M factor.

System

MODIFY PARAMETERS S/CODES (of sensors)

Each class of sensors has several operating parameters that can be user-modified. These are: acquisition rate; advance time (compared to data acquisition) of power feeding the actuator (if any) linked to the sensor; engineering parameters. The classes are identified by operating codes (see the Quick Reference Table for **LSI LASTEM** sensor Operating Codes in part 8). Parameter modification can be accessed by SYSTEM ->PARAMETER S/CODES MODIFICATION. The sensors that acquire or calculate more than one value will have the same number of operating sub-codes as the acquired and/or calculated parameters (max.4).

Examples
1) The operator decides to modify the operation parameters applicable to sensor LSI LASTEM-mod.BST110. He searches for the corresponding operation code (n°21) in the "Quick reference table" for LSI LASTEM sensor codes. In the "Sensor and signal class operating codes table" he now looks for "Op.Code 21", which corresponds to sub-code "S/code" no.13. At this point he opens the "Modify parameters s/codes" option, positions the cursor on no. 13, and modifies the parameters..
2) The operator is using Psychrometric probe BSU101.
In the quick reference table he finds the probe operating code (no. 11). In the "Sensor and signal Operating Codes" table he looks for "Op. Code no. 11" and its relevant "S/code":
- Dry temperature with forced ventilation (no. 1)
- Humid temperature with forced ventilation (no. 2)
- Relative humidity (no.151)
- Dew point (no.152)
The operator must input the same acquisition and enabling rates for each sub-code.
You can also find a sub-code also by pressing the "right arrow" key in the "LIST OF ACTIVE CHANNELS” screen during the Survey "Set-up" stage.

This function is used for the linear conversion of the output data values.

Non-logic state engineering sub codes
The operator wishes to display and store a 0/300 mV signal signifying -20..+100.
By finding the suitable code in the "Operating Codes" table, he will modify the parameters of the corresponding sub-code, using "SYSTEM -> MODIFY PARAMETERS" as follows: Example:
Parameter 1: lower limit for input signal (0)
Parameter 2: upper limit for input signal (300)
Parameter 3: lower limit for engineered datum at output (-20)
Parameter 4: upper limit for engineered datum at output (100)

Note: the symbol "-" (negative) is set by using the “A” key in the first box of the line.
The decimal point is set using the "OFF END" key

Modify the limits of the state or presence sub-codes (73, 78, 79, 80)
The operator can program the interval limits of the logic state signal (max. amplitude 0+300 mV) and set the threshold above and below which it switches itself. Example
STATE OFF : + 00000.000 (it accepts a value from 0 to 150 and displays NO on the screen)
STATE ON : + 00300.000 (it accepts a value from 150 to 300 and displays YES on the screen)
THRESHOLD : + 00150.000

The settings are saved in the EEPROM memory and will remain unchanged as soon as the next time the operator chooses to modify them.

See also: " ACQUISITION RATE, ACTUATION RATE, ENGINEERING PARAMETERS

Survey

NEW SUB-SURVEY

The operator can start a new Survey having the same number as the preceding one but with a different sub-number. This may become necessary when the operator wishes to group together all the Surveys of a certain type (e.g. executed in a given location) using the same Survey numb., but with a different sub-Survey numb.. While the Survey is in progress, go to "New sub-Survey", press IMMIS to confirm your selection, and start the new sub-Survey, pressing any key (except ON).

Example
The operator has started Survey no. 002/001 and wishes to carry out a Survey in another point of the room. He must select "New Sub-survey" and confirm the selection - when confirmed, sub-Survey 002/001 will end. The operator can now move the sensors and, when everything is ready, he can start Survey no. 002/002 by pressing any key.

See also: "SURVEY/SUB-SURVEY NUMBER, BATTERY VOLTAGE"

Printouts

PARAMETERS IN USE (Printout)

By printing the "CURRENT PARAMETERS" list the operator can obtain a hard copy of all the settings currently active on the instrument, i.e.: transmission rate, acquisition rate multiplication factor, survey duration, radiometer calibration, acquisition rate, actuation rate and engineering parameters.

Comm.

PROTOCOL INFORMATION

While uploading data from BABUC to PC, the operator can display serial line activity by selecting the "Protocol information" option. When the serial line is active, a series of numbers will scroll on the display with the following meaning:
Tx: information transmitted by BABUC. Rx: information received by BABUC.
Frm: quantity of "packets" transmitted or received.
CAR: quantity of "characters" transmitted or received
This option is particularly useful for deciding whether possible communication failures are caused by BABUC or by the system connected to it.

Comm.

PROTOCOL ID

From 2 to 32 BABUC/A units can be connected in series by means of an RS485 serial connection. This type of interface allows the user to install the instruments at considerable distances from each other and control them from a single PC. The "Protocol ID" number allows the user to make connections of this type, assigning a different Protocol ID to each instrument in the network. ID numbers from 2 to 254 must be used, but in any event, communication must be carried out using the serial number of the instrument concerned.

Survey

RESET STATISTICS

While statistics are being displayed, it is possible to reset the statistics count with the "Reset Statistics" function. Do this by positioning the cursor on "RESET STATISTICS" and confirming your selection or press “F1/”.

Example
To display data in a statistical format, enter “Visualization”, choose the "Statistics" display and press "IMMIS". Values for time elapsed since the start of the survey or since the last "Reset Statistics" operation will be displayed. If the operator wishes to reset the statistics display, he must press "ESC", shift the cursor to "RESET STATISTICS" and confirm the selection.

Survey

SET-UP

The "SET-UP" stage of a Survey with storage is used to set and check the parameters that enable a Survey to be executed:
- start date/time and duration of Surveys with storage (see Survey start/duration)
- selection of type of radiometer for connection (see Calibration factor)
- programming acquisition rates (see Reset Acquisition Rates)
- selection of Survey or sub-Survey number. (see Survey/sub-Survey number).

See also: "EXECUTION, ACQUISITION RATE of the probes"

Utilities

SYSTEM DATE/TIME

BABUC/A is equipped with a clock that is self-powered by rechargeable batteries with a duration of one year. The clock enables the instrument to store the date and calendar in its memory. BABUC/M is equipped with a non self-powered clock, therefore data must be set each time the instrument is switched on. To reset or modify the date and time of the clock, use the "System date/time" function. The date/time cannot be modified when the survey is “in progress”.

System

STANDARD PARAMETERS

BABUC can perform some specialized calculations. In addition to the values acquired from the probes, these calculations also need some parameters that can be inserted by the operator. One example is the calculation of the pipe delivery which requires the air speed value acquired from the probe and the pipe geometry (standard parameter) inserted manually by the operator.
There are other parameters which require standard parameters. One example is the operation of “Pitot tube” anemometers. In this case air speed measurement is influenced by temperature and height above sea level at which the differential pressure is measured; or in case of use of the CO2 gas concentration probe (BSO103) the temperature and pressure parameters will counteract the measurements.
Once standard parameters are set they do not change and they reside in the EEPROM memory. They can be changed only if they are used to calculate the derived parameters within the VISUALIZATION mask. They are:
- temperature (default 25°C)
- gravity (default 9.806 G)
- atmospheric pressure (default 1013.25 mB)
- height above sea level (default 0 m)
- Latitude (default 45 °N) set to switch from N to S or vice versa.
- Longitude (default 9.00 °E) set to switch from E to W or vice versa.
- Room volume m³
- Pipe dimensions cm (Circular/Rectangular/Pipe factor)
- Light source distance

Atmospheric pressure and altitude are correlated according to the following formula, which assumes that air temperature remains constant at different altitudes. The formula also disregards changes in gravitational acceleration "g" since the changes with respect to altitude are insignificant.

$P = Po * e^{-ay}$

Where:

P = Pressure at various altitudes(hPa)
Po = Pressure at sea level (hPa) = 1013.25 hPa
e = neper number (2.718281828)
a = Multilication factor proportional to air density at sea level temperature (K) and earth’s gravitational field (standard value = 9.80665)
y = Height above sea (Km)

System

STATIC MEMORY TRANSFER

The data acquired are initially stored in the RAM dynamic memory and then transferred periodically, in packets, to the non-volatile EEPROM memory. This data transfer is performed in any case when the RAM is full or at the end of the survey. During uploading of data to a PC using “ADVANCED INFOGAP” software, the transferred data will be those stored in the EEPROM memory. The transfer rate is set by the factory at 15 minutes. It can, however, be changed in the "STATIC MEMORY TRANSFER" option. It may prove necessary to change the rate if the operator wishes to transfer data using ”INFOGAP ADVANCED” software, while a survey is in progress. This will enable the transfer of the most recent acquisitions. Alternatively, the rate must be changed when the programmed survey lasts less than 15 minutes, in which case it is advisable to enter a transfer rate that is only slightly greater than the duration of the survey.

Survey

SURVEY INDEX

The "*Index*" function provides information on all Surveys stored in the BABUC memory:
- Survey and sub-Survey number
- Date-time of Survey/sub-Survey "Start"
- Date-time of Survey/sub-Survey "End"
- Dimensions in bytes of the Survey/sub-Survey

Use the right and left arrows to skip to the first or last Survey listed.

Printouts

SURVEY INDEX (printout)

This function is used to print the BABUC files index.
The printed index provides the following data for each Survey:
- number and sub-number
- starting date/time
- end date/time
- a description of connected sensors
- measuring unit for all connected sensors
- acquisition rate for all connected sensors
- Channel number of all connected sensors

See also "TABULAR PRINTOUTS"

Survey

SURVEY START/DURATION

During the "SET-UP" phase it is possible to program the start and duration of the Survey as follows: Start: immediate or delayed to a given date/time. Duration: unlimited or defined (maximum 999 days and 23.00 hours). During these functions, BABUC indicates its memory time availability for the Survey in question. If necessary, the operator may optimize memory availability by modifying the acquisition rate or deleting other surveys from memory.

Examples
1) At 14.00 hours the operator starts the procedure of a programmed Survey with delayed start at 15.00 hours and duration of 5 hours. BABUC executes the procedure displaying the following messages:
- from 14.00 to 15.00 hours: "Survey activated"
- from 15.00 to 20.00 hours: "Survey in progress"
- from 20.00 hours on: "Survey executed".
2) At 14.00 hours the operator enables the execution of a Survey programmed to start immediately and lasting 5 hours. BABUC executes the procedure displaying the following messages:
- from 14.00 hours to 19.00 hours. "Survey in progress"
- from 19.00 hours: "Survey executed"
3) At 14.00 hours the operator starts execution of a Survey programmed to start immediately and of unlimited duration. BABUC executes the procedure and displays the following message:

- from 14.00 hours on: "Survey in progress"

Survey

SURVEY AND SUB-SURVEY NUMBER

Each stored Survey is identified by a "Survey and sub-Survey number".
These two numbers will be useful for subsequent Survey management, both for printing and on the PC. During the "SET-UP" stage, BABUC suggests a Survey number to the operator, that is increased by one unit with respect to the previous Survey number. The operator may either accept this number or input another higher or lower number. If the operator starts the Survey without going through the setting stage, the Survey will automatically bear the number following the number of the last Survey run by BABUC.

Example
The operator has executed and completed Survey no. 020/001; if he does not activate the "SET-UP" stage, the next Survey will automatically be numbered as 021/001; if the operator executes a new "Set-up" stage, BABUC will suggest number 02/001 which may be accepted or modified.

During a Survey, it may be necessary to subdivide it into sub-surveys. To carry out this operation, the operator must activate the "New Sub-survey" option; the Survey activated in this manner will have the same number as the preceding one but will bear the successive Sub-survey number.

Example
The Survey started is number 020/001; the operator decides to change the measuring location by moving the sensors; in this case, instead of "Survey end" it may be preferable to activate a new sub-Survey. The sub-Survey started in this manner will be automatically assigned with the number 020/002.

If battery voltage drops below a safety threshold during a survey, BABUC stops the survey and automatically re-starts it using a higher number when power returns to the correct value.

See also: "NEW SUB-SURVEY, EXECUTION, BATTERY VOLTAGE"

Printouts

TABULAR ELABORATES (Printing)

Connect BABUC to the printer and check that the two systems are compatible (see par. 11 of Part 2).
Open the main menu, shift the cursor to "Printouts" and select the printing option "Processed data in tables".
- Using the up and down arrows, select the Survey to print and confirm by pressing "IMMIS".
- Indicate whether you intend to print all parameters or a selection of parameters.
- Select the parameters you wish to print, locating the cursor on the options: YES or NO.
- Select date/time of the start and end of the period to be printed. Complete surveys or parts of surveys can be selected.
- Input the statistical time base required for processing. BABUC will prompt for the processing base to calculate the statistics.

If the statistical value for the entire Survey is required, do not make any alterations but leave 00:00:00 as the processing base. BABUC will print all the processed values in tables using the requested processing base. Printing may be interrupted at any time by pressing any key (except "ON") and confirming the selected period. If value 00:00:00 is input as "Processing time", BABUC will print a single bar corresponding to the entire Survey.

System

USING ± 4 VOLT CHANNEL

(BABUC/A only)
If the ± 4 channel is used, it will be necessary to activate the "USING ± 4 VOLT CHANNEL" option. This channel is used for probes not manufactured by *LSI LASTEM* which have this output signal.

System

USING DIFFERENTIAL PRESSURE SENSOR

Differential pressure sensors can be used as barometers to all effects and purposes in order to measure differential pressure, or alternatively, in conjunction with Pitot tubes, to measure air speed and pipe air delivery (Air changes are excluded). When BABUC recognizes a differential barometer connected to one of the channels, it must be informed whether the barometer must be used only to measure the differential pressure (mB) or air speed (m/sec). The operator in the option "SYSTEM ->USING DIFFERENTIAL PRESSURE SENSORS" and select the purpose for which the differential barometer is to be used. If "Speed" is selected, BABUC will interpolate the pressure values with the air temperature value. The air temperature value can be acquired with a temperature probe connected to BABUC (*) or, without a thermometer, by setting the temperature value in SYSTEM -> STANDARD PARAMETERS -> TEMPERATURE. At the moment in which the differential barometer is selected to calculate the air speed with a Pitot Tube, BABUC asks if the reference temperature to be used is the one acquired or set (in STANDARD PARAMETERS). (*) If the operator should connect two temperature probes, BABUC will refer to the measurement acquired with the probe connected to the input immediately before the input to which the differential barometer is connected.
If the operator uses two differential probes, BABUC will always consider the same temperature.

Sistema

THERMISTOR AIR SPEED SENSOR

When a theristor air speed sensor is connected, Babuc shows and records:

- Air speed
- Air temperature
- Relative humidity.

Air speed measurement with a thermistor sensor is temperature and pressure dipendent: temperature is directly measured by the temperature sensor on board (repentine temperature changes acquired from the probe require a set time from 5 to 30 seconds, depending of the temperature delta occurred);; atmosferic pressure must be set on Babuc in the menu SYSTEM -> STANDARD PARAMETERS -> ATM. PRESSURE (default 1000 mBar); if the atmospheric pressure is not available, you can set the height of the site in the menu SYSTEM -> STANDARD PARAMETERS -> HEIGHT (default 115 m).

Thermistor air speed sensor was calibrated from factory at 1000 mBar. If no pressure is set on Babuc, there would be a 0.1 % of error for any mBar of difference between real atmospheric pressure and Babuc's setting pressure (default 1000 mBar).

Survey

VISUALIZATION

The "Display" option is used to display the data being acquired by the instrument.
Depending on the type of sensor connected, BABUC displays the values measured with different logic in relation to the physical type of parameter: Generic sensor, Impulse sensor, Logic state sensor. Two display modes are available: synthetic and statistical. The "Synthetic" display mode consecutively shows all instantaneous values relayed by the connected sensors. A longer description exceeding screen limits can be viewed by pressing the "right arrow" and "left arrow" keys. In addition, a flashing indicator will be activated when the statistical computation is in progress. The "Statistical data" display mode of generic sensors shows the following data for each sensor:

- instantaneous value
- maximum value* with date and time
- mean value*
- minimum value* with date and time
- standard deviation*
- the difference between the last two instantaneous values
- the number of acquisitions since the start of the Survey
- the number of acquisitions since the last "STATISTICS RESET".
- time elapsed from the start of Survey or from the last "STATISTICS RESET".
- the real acquisition rate

The "Statistical data" display mode of impulse sensors shows the following data for each sensor:

- instantaneous value (impulses/minute)
- maximum value (impulse/minute) with date and time*
- Total impulses*
- the number of acquisitions since the last "STATISTICS RESET".
- time elapsed from the start of Survey or from the last "STATISTICS RESET".

The "Statistics" display mode of a Logic state sensor shows the following data for each sensor:

- instantaneous value of the logic state
- Number of YES and total of the YES time
- Number of NO and total of the NO time
- the number of acquisitions since the last "STATISTICS RESET".

(* Referred to the time elapsed from the start of the survey or from the time of the last "STATISTICS RESET").

During Surveys "with storage", values are updated on the display at a speed equal to the acquisition speed of the specific sensor connected.
During Survey "without storage", data are updated at a speed in seconds equal to the number of sensors connected.

Example: Assuming the operator has 5 sensors connected, each with an acquisition rate of 1 minute: for Surveys with storage the display is updated every minute, while for Surveys without storage, the display is updated every 5 seconds.

If key "F2/-" is pressed while statistical display is in progress, you can stop and restart the calculation and display of statistical values. This operation will not interrupt data storage (if this function is set).

Example: To measure the flow rate of a pipeline for a time unit of one minute:
- *select "Statistical display"*
- *press "F2/-"*
- *perform a statistics reset and open the statistical display mode again*
- *when the instantaneous value is representative, press "A" to start statistical computation*
- *press the "down arrow" to view the mean value and press the "right arrow" to show the clock*
- *wait one minute and then press "F2/-" to stop the statistical computation.*

Survey

WITH STORAGE

BABUC may be used as a display/storage instrument or simply as a display unit only.
In the "Survey" function, the first request made by the instrument is whether the measurement to be carried out requires data storage or not. Subsequent requests for instructions will depend on this first selection, as follows:

With storage	Without storage
Set time/date (BABUC/M only)	Set time/date [BABUC/M only]
Start/duration of Survey	Radiometer calibration code (if connected)
Radiometer calibration code (if connected)	
Available storage space	
Accept configuration	
Display acquisition rates	
Reset acquisition rates	
Insert survey number	

The quantity of storage space occupied by a Survey is correlated to the number of logic channels generated by the sensors connected and to the acquisition rate assigned to each of them. If the Survey is not stored, the acquisition rate and display updating will be as rapid as possible depending on the number of logic channels generated by the sensors connected.

See also: "MEMORY AVAILABILITY, ACQUISITION RATE, RESET ACQUISITION RATE, EXECUTION"

PART 5 - ERROR MESSAGES

Error messages may appear while the instrument is operating. They can indicate either internal faults or incorrect operations by the user. Some errors (marked below with an *) must be recognized and deleted from memory by using the function ERROR MANAGEMENT -> DISPLAY->DELETE.
The following chart indicates possible error messages with troubleshooting advice:

Message	Description	Remedy
Battery low +	At start of Survey, the instrument checks if battery voltage is sufficient to continue.	If Alkaline batteries are used, change batteries. If rechargeable batteries are used, power instrument from the mains. Eliminate the error in UTILITIES-ERROR MANAGEMENT-DELETE.
datum not found: *	An unrecognizable program error has occurred. It may have been caused either by an operation fault in the microprocessor or in the dynamic memory (RAM). Some data items in the static memory may be incorrect.	Same procedure as for the write timeout error.
high acquisition frequency:	Reading frequency of the connected sensors exceeds instrument capacity. Minimum rate is one second for each connected sensor, so if 5 channels are created, none can have an ACQUISITION RATE of less than 5 seconds.	Increase the ACQUISITION RATE either with the appropriate multiplication factor (SET-UP) or modify the ACQUISITION RATE for the sensor (SYSTEM - MODIFY PARAMETERS).
Survey not set correctly:	The Survey setting procedure has not been completed correctly due to an error or because the user has abandoned the operation. No measurement should be started under these conditions, because the measurement setting data are incorrect or insufficient.	Start a new "SET-UP" stage.
data memory insufficient:	The dynamic memory (RAM) reserved for temporary storage of data read by the sensors is insufficient.	Set a shorter data transfer time (SYSTEM -TRANSF. STATIC MEMORY) or make the acquisition times of the connected sensors multiples across the sensors. In this manner the instrument uses less memory to create a data block to transfer to the static memory.
memory full: *	The current Survey or the last one executed has attempted to store the acquired data in excess of the space available in the static memory. This has resulted in loss of data. However, the resident data remains perfectly valid.	Eliminate the error with the appropriate menu option. Before starting a new Survey, eliminate one or more Surveys from the memory (Files-Delete Last-All)

Message	Description	Remedy
Static memory not formatted:	This error may appear when the instrument is switched on. It indicates that the static memory has lost the basic information that allows it to be used by the program. In case of formatting, all data contained in the memory are lost (data memory + program memory) and the instrument cannot be used.	If the memory contains Surveys not yet uploaded or printed, continue without formatting and transfer them immediately to the PC or have them printed; these two operations may not be possible. Restart the instrument, format the memory and follow the procedure for the write timeout error.
no sensor connected:	The operator is trying to set or execute a Survey without having connected any sensors.	If at least one sensor is installed, check that the connector is fitted correctly and that an input suitable for the sensor is being used. Should the error continue, check if the connector pins or the sensor cable are damaged. If possible, change the input of the sensor (but only if using a type of sensor automatically identified by the input). If the outcome of all the tests is negative, the acquisition device or the faulty sensor must be returned to the factory for repairs.
not recognized: *	A read or write operation, not recognized by the system, has been performed in the static memory. The operation could have been caused by an operation fault in the microprocessor or in the dynamic memory (RAM). Some information items in the static memory may be incorrect.	Follow the same procedure as for the write timeout error.
incorrect password:	The instrument is protected by a password against unauthorized use.	If the password was input by the user but is no longer valid, the only way out of this state is to cut off power to the instrument by disconnecting the internal batteries. If a measurement is in progress, the instrument will lose only information not yet backed up in the static memory. In other cases no data will be lost. If the password was not input by the user, this means that the operator is in a section of the program protected by *LSI LASTEM*. Contact *LSI LASTEM* for approval to proceed.
selected period is incorrect:	The selected period is incorrect because the first date or time input does not precede the second one.	Input the two dates again correctly.
pointer error: *	Indicates that, following incorrect writing of data in the static memory, one or more information items are invalid.	Proceed as for the write timeout error.

Message	Description	Remedy
read after write: *	This message has a similar meaning to write timeout. It indicates that information written in the static memory was not accepted by the read after write check.	Follow the procedure for the write timeout error.
request not avail.:*	See datum not found.	See datum not found.
faulty sensor:	Faulty sensor connected.	Replace the sensor or check correct connection as under the no sensor connected error.
unrecognized sensor:	The connected sensor has not been recognized as one of the programmed sensors.	Program the sensor using the Set-up program on the PC, or check if sensor is connected correctly as in the no sensor connected error.
sensors do not corresp.:	During the Survey start stage, the instrument has detected that the connected sensors do not correspond (in terms of quantity, type or layout) to those defined in the last Survey setting.	Modify or replace the sensors connected or execute a new setting. The error may appear also if the sensor-instrument connection is incorrect. Proceed as for the no sensor connected error.
printer not ready:	The printer connected to the instrument has run into a problem while printing; the most likely one is paper out.	Solve the printing problem as illustrated in the printer manual.
too many logic channels:	The total number of sensors and processing operations set for the Survey exceed instrument capacity.	Reduce the number of sensors connected or reduce the number of processing operations for the sensors connected using the Set-up program on the PC.
off-scale value: *	An information item has been requested from the static memory, with an address exceeding the permitted value. This may be caused by an operation fault in the microprocessor or in the dynamic memory (RAM). Some information items in the static memory may be incorrect.	Follow the procedure as for the write timeout error.

Message	Description	Remedy
Too many probes	The instrument has detected a number of probes connected to its inputs that exceed the maximum allowed. This error could occur if some informations in the static memory are uncorrect or can be caused for an internal circuit failure.	Follow the procedure as for the write timeout error.
Invalid reference	A probe has an invalid reference to another probe.	Call *LSI LASTEM* and refer about the connected probes.
Undef. sensor	A connected probe uses a codop not defined in the static memory.	If it is not an original *LSI LASTEM* probe check if the recognition resistance match one of the resistances in the free codop list; if it is an original *LSI LASTEM* probe follow the procedure as for the write timeout error.
Probes without store	None of the connected probes is configured for data storage, even if is used the survey with storage facility.	Use the Setup program to enable the memory storage for the codops relative to the used probes.
uncorrespond. Probe	The probes are connected in different order or number respect the previously programmed survey.	Follow the correct order and number of probes previously programmed or, in alternative, restart the setup of the survey with storage.
write timeout:	Indicates that writing of data items in the static memory (EEPROM) was not executed correctly. Therefore the contents of the static memory do not correspond exactly with the data memorized by the program.	In this case all Surveys must either be uploaded on the PC or printed and then deleted from memory (delete all).Uploading or printing may not be possible because of incorrect information in the static memory. After this operation, it is advisable to transfer from the PC to BABUC all configuration supplied by *LSI LASTEM* in the PC Set-up program. The following information should be transmitted: System, Measurement, Static Codes, Sensor Allocation, Channel Calibration. (See the section of the INFOGAP ADVANCED VERSION software manual regarding “How to restore correct operation of BABUC from a PC”). In this way BABUC will once again contain the original factory settings. If this problem occurs frequently, the static memory or one of the components associated with it has developed a fault. In this case send BABUC to the factory for repairs.

PART 6 - CONNECTING "NON *LSI LASTEM*" SENSORS

To use sensors in BABUC that are not set for such an instrument, they must be connected by using the following *LSI LASTEM* connectors :

BSH900.1 Connector for sensors with output 0-20 mA or 4-20 mA
BSH905.1 Connector for sensors with output ± 4 Vdc
BSH907.1 Connector for sensors with output in mV (-10+300 mV) and resistance (Pt100, N100)
BSH904.1 Connector for sensors with impulsive output (TTL)

The physical connection of the cable is described on the next page.

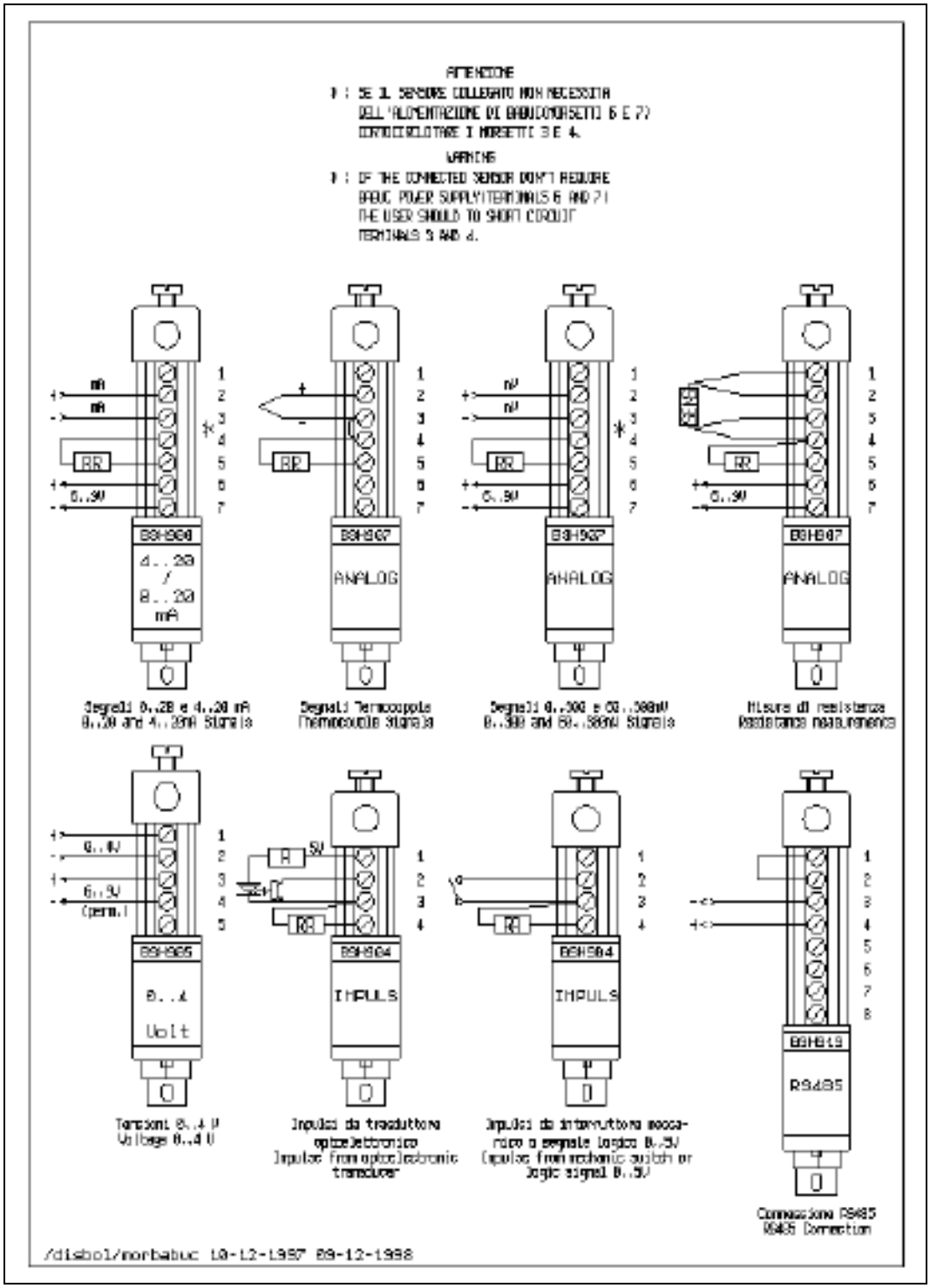
If the sensor to be connected has characteristics (analytical description of the parameter, electric output signal, text, unit of measurement) that are similar to one of the sensors already described in the Operating Code Table (Part 8), do the following:

1) Consult the "Operating Code Table" (Part 8) and find the operating code (Op. Code) of the sensor that reports the physical-electrical characteristics and the type of treatment that is closest to the one required (texts, parameters, measurement field, engineering).
2) Measure the value of the corresponding rated recognition resistance.
3) Connect the wires from the sensor and any power supply (6-9 Vdc) of the sensor associated to it to the connection terminal board, as well as the recognition resistance (RR), as indicated in the drawing on the next page.
4) If necessary, open the "SYSTEM -> MODIFY PARAM. S/Cod." menu and select the sub-code (Op. S/Cod) corresponding to the operating Code (Op. Code) identified in point 1. If necessary, modify:
   - Acquisition rate (see ACQUISITION RATE in Part 4)
   - Actuation rate (see ACTUATION of the Sensor Part 4)
   - Engineering parameters (see "Engineering parameters " in Part 4)
5) Connect the sensor to one of the physical inputs corresponding to the type of sensor signal. The sensor will be recognized by the instrument and treated accordingly.

It is possible to change other parameters, relative to a previous code, that cannot be modified directly on BABUC, by using the SETUP module on the PC of the InfoGAP Advanced software version.

A new operating Code can be created by using the SETUP module on the PC of the InfoGAP Advanced software version.

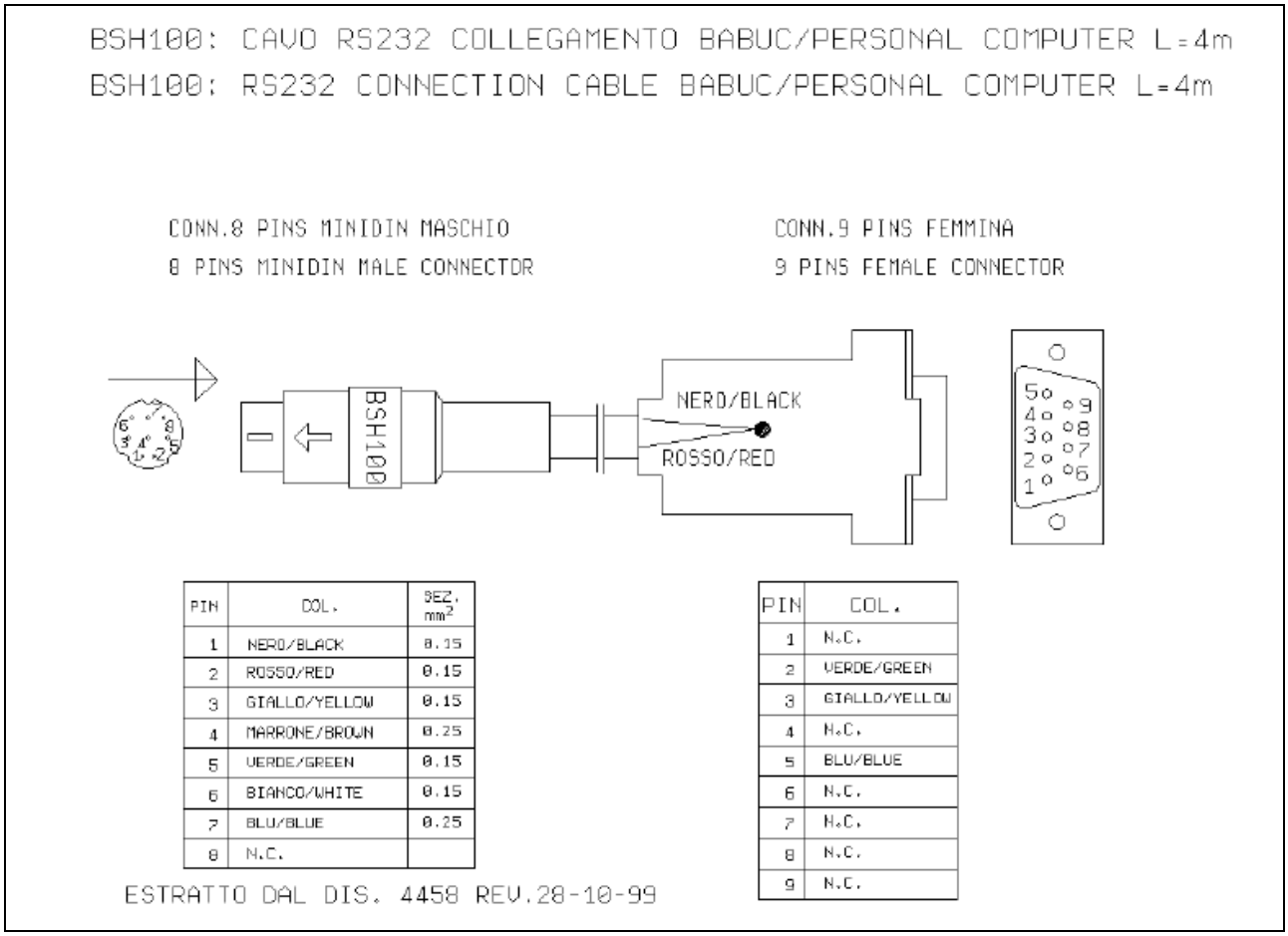
1) Assign the Operating code selecting it from one of the first 10 codes (Op. Code) of the “Operating Code Table” (Part 8) for analogueue sensors and the code (Op. Code) 159 for impulsive sensors.
2) Measure the value of the corresponding rated recognition resistance.
3) Connect the wires from the sensor and any power supply (6-9 Vdc) of the sensor associated to it to the connection terminal board, as well as the recognition resistance (RR), as indicated in the drawing on the next page.
4) Operate on the InfoGAP Advanced version SETUP module to create the operating Sub-code (max. 3 : 109, 110, 111).
5) Connect the sensor to one of the physical inputs corresponding to the type of sensor signal. The sensor will be recognized by the instrument and treated accordingly.


ATTENZIONE
N : SE IL SENSORE COLLEGATO NON NECESSITA
DELL'ALIMENTAZIONE DI BABUCM(MORSETTI 6 E 7)
OCCORRE CORTOCIRCUITARE I MORSETTI 3 E 4.
WARNING
N : IF THE CONNECTED SENSOR DON'T REQUIRE
BABUC POWER SUPPLY(TERMINALS 6 AND 7)
THE USER SHOULD TO SHORT CIRCUIT
TERMINALS 3 AND 4.
mA
RR
0..30
B8H906
4..20
/
8..20
mA
Segnali 0..20 e 4..20 mA
0..20 and 4..20mA Signals
B8H907
ANALOG
Segnali Termocoppia
Thermocouple Signals
mV
B8H927
Segnali 0..300 e 60..300mV
0..300 and 60..300mV Signals
Misure di resistenza
Resistance measurements
0..4V
6..5V
(perm.)
B8H905
0..4
Volt
Tensioni 0..4 V
Voltage 0..4 V
5V
R
B8H904
IMPULS
Impulsi da trasduttore
optoelettronico
Impulse from optoelectronic
transducer
Impulsi da interruttore mecca-
nico o segnale logico 0../5V
(pulse from mechanic switch or
logic signal 0..5V
B8H819
RS485
Connessione RS485
RS485 Connection
/disbol/norbabuc 10-12-1997 09-12-1998

PART 7 - SERIAL CONNECTION BETWEEN BABUC AND PC

There are various ways of connecting BABUC to a PC:

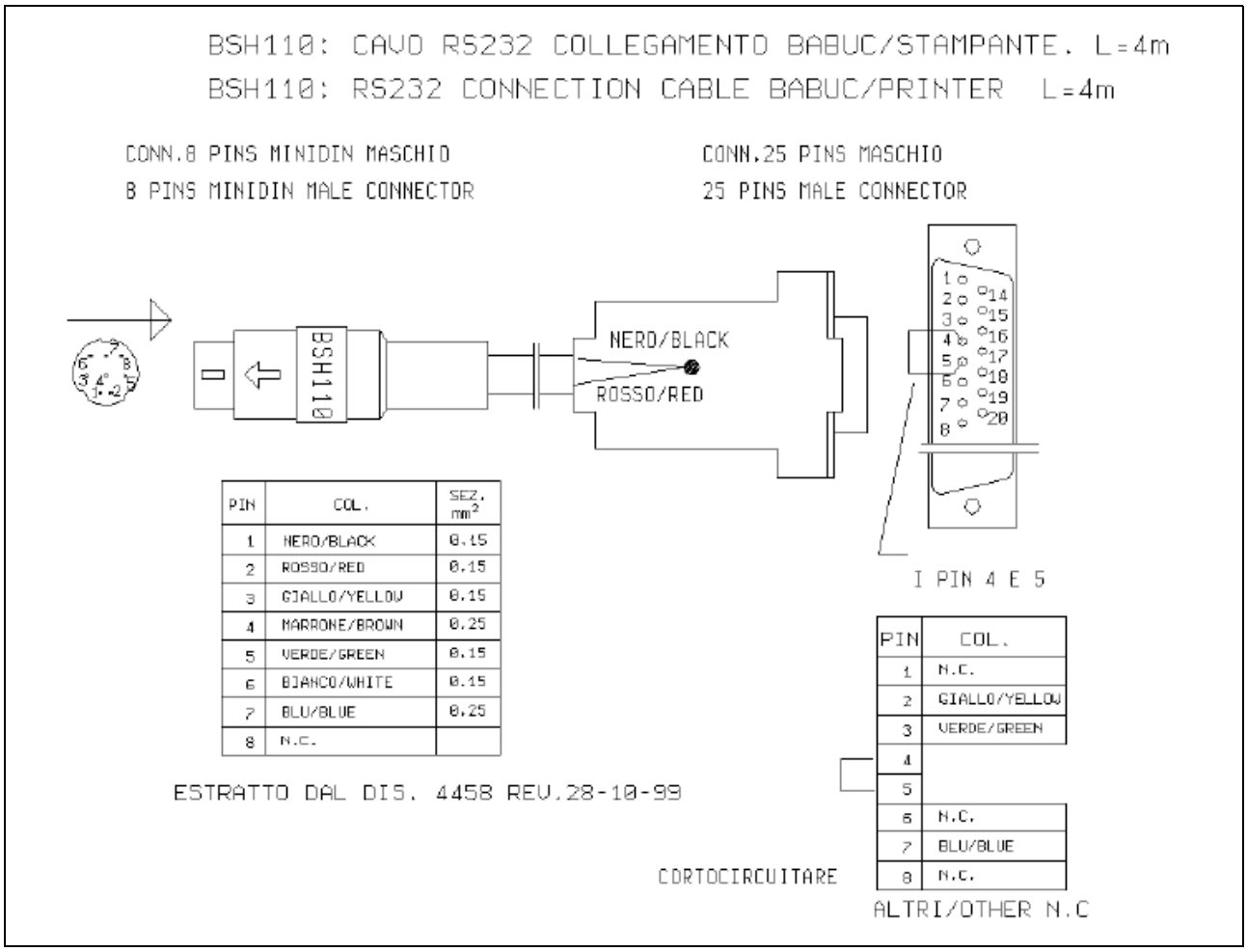
1) Direct connection on an RS232 serial line: the distance between the two systems must be no greater than 15 m; it is possible to use a BSH100 cable (L = 4 m).
2) Direct connection on an RS485 serial line: BABUC/A can be supplied with an RS485 serial line; in this case you can use either the BSH105 cable (L = 10m) for an RS485 serial connection, or, for distances greater than 10 m, a system consisting of a terminal board (BSH919) installed on BABUC and a two-wire cable. In any event the connection must be made to the RS485 port on the PC.
   BABUC/M does not have a standard RS485 output; if you wish to make an RS485 connection use an adaptor (RS232 -> RS485) in the RS232 output connection of the instrument. The adaptor will be connected, by means of a two-wire cable, to an RS485 -> RS232 converter installed on the PC.
3) Connection of several BABUC instruments “in series” via an RS485 line: you can connect up to 32 BABUC/A units “in series”. In this case the instruments will be connected by means of a system consisting of two terminal boards (BSH919) on the instruments themselves and a cable installed by the operator. The last BABUC unit in the network will be connected to the RS485 port of the PC. The distance between the PC and the last BABUC unit in the network must be not greater than 500 m.
4) Connection by modem/telephone line: one or more BABUC unit(s) can be connected to the PC over a modem link. In this case each BABUC unit will be connected to its modem by means of cable (BSH109).



PIN	COL.	SEZ. mm²
1	NERO/BLACK	0.15
2	ROSSO/RED	0.15
3	GIALLO/YELLOW	0.15
4	MARRONE/BROWN	0.25
5	VERDE/GREEN	0.15
6	BIANCO/WHITE	0.15
7	BLU/BLUE	0.25
8	N.C.	

PIN	COL.
1	N.C.
2	VERDE/GREEN
3	GIALLO/YELLOW
4	N.C.
5	BLU/BLUE
6	N.C.
7	N.C.
8	N.C.
9	N.C.

BSH100 cable scheme – Babuc/PC



PIN	COL.	SEZ. mm²
1	NERO/BLACK	0.15
2	ROSSO/RED	0.15
3	GIALLO/YELLOW	0.15
4	MARRONE/BROWN	0.25
5	VERDE/GREEN	0.15
6	BIANCO/WHITE	0.15
7	BLU/BLUE	0.25
8	N.C.	

PIN	COL.
1	N.C.
2	GIALLO/YELLOW
3	VERDE/GREEN
4	
5	
6	N.C.
7	BLU/BLUE
8	N.C.

BSH110 cable scheme – Babuc/Printer

PART 8 - SENSOR CODE - SUBCODE TABLES

Use of the tables
There are two tables for identifying the code of all parameters that can be measured using BABUC:

- TABLE OF OPERATING CODES FOR SENSOR AND SIGNAL CLASSES
- QUICK REFERENCE TABLE FOR *LSI LASTEM* SENSOR OPERATING CODES

If it is necessary to modify the acquisition rate, actuation or engineering parameters for an *LSI LASTEM* probe, find the commercial code of the relevant sensor in the *LSI LASTEM* sensor operating code quick reference table. Each commercial code is associated with an operative code.
In the table of “Operating codes for sensor and signal classes”, given the operating code (Op.Code), it is possible to find the sub-code of the sensor (S/Code) that must be called in the SYSTEM -> MODIFY PARAM.S/ code menu.

TABLE OF OPERATIVE CODES FOR THE SENSOR AND SIGNAL CLASSES 11 to 20

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters	
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input	Output
11	218	215	1	TR Pt100 SMPT68-IEC751 - Dry bulb temperatur, forced ventilation	2	TeDRYBULBvf	°C	10	180	-50+600°C		
			2	TR Pt100 SMPT68-IEC751 - Humid bulb temperature, forced ventilation	3	TeWETBULBvf	°C	10	180	-50+600°C		
			151	- Psychrometric relative humidity calculation, ISO 7726	21	RelHUMidity	%	10		0..100%		
			152	- Dew point calcultation. ISO 7726	19	TeDewPoint	°C	10		-50+150°C		
12	232	229	3	TR Pt100 SMPT68-IEC751 - Dry bulb temperature, natural ventilation	4	TeDRYBULBnf	°C	10		-50+600°C		
			4	TR Pt100 SMPT68-IEC751 - Humid bulb temperature, natural ventilation	5	TeWETBULBnv	°C	10		-50+600°C		
			151	- Psychrometric relative humidity calculation, ISO 7726	21	RelHUMidity	%	10		0..100%		
			152	- Dew point calcultation. ISO 7726	19	TeDewPoint	°C	10		-50+150°C		
13	246	243	5	TS TSB-LSI LASTEM - Dry bulb temperature, forced ventilation	2	TeDRYBULBvf	°C	10	180	-50+140°C		
			6	TS TSB-LSI LASTEM - Humid bulb temperature, forced ventilation	3	TeWETBULBvf	°C	10	180	-50+140°C		
			151	- Psychrometric relative humidity calculation, ISO 7726	21	RelHUMidity	%	10		0..100%		
			152	- Dew point calcultation. ISO 7726	19	TeDewPoint	°C	10		-50+150°C		
14	258	255										
15	271	268	9	TR Pt100 SMPT68-IEC751 - General temperature	1	Temperature	°C	10		-50+600°C		
16	284	281	3	TR Pt100 SMPT68-IEC751 -Dry bulb temperature, natural ventilation	4	TeDRYBULBnf	°C	10		-50+600°C		
17	300	297	4	TR Pt100 SMPT68-IEC751 - Humid bulb temperature, natural ventilation	5	TeWETBULBnf	°C	10		-50+600°C		
			166	-WBGT int calculation ISO 7243	95	WBGTint	°C	10		-50+150°C		
			166	-WBGT ext calculation ISO 7243I	96	WBGText	°C	10		-50+150°C		
18	320	316	10	TR Pt100 SMPT68-IEC751 - Globe-thermometric temperature, natural ventilation	9	TeGLOBETH.nv	°C	10		-50+600°C		
				S/codop. 177 and 178 for CET calculation can be inserted								
19	340	336	11	TR Pt100 SMPT68-IEC751 - Globe-thermometric temperature, forced ventilation	8	TeGLOBETH.fv	°C	10	180	-50+600°C		
				S/codop. 177 and 178 for CET calculation can be inserted								
20	361	357	12	TR Pt100 SMPT68-IEC751 - Temperature of flat black body	10	TeBlackBodyFlt	°C	10		-50+600°C		

follows TABLE OF OPERATIVE CODES 21 TO 40

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters	
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input	Output
21	383	379	13	TR Pt100 SMPT68-IEC751 - Surface temperature	6	TeSURFACE	°C	10		-50+600°C		
22	407	402	14	Linear analogue signal - Speed air	115	Vel.AIR	m/s	3	3	60+300mV	Param1 60 Param2 300	Param3 0 Param4 30
23	432	427	15	TS TS-S1-LSI LASTEM - Physiological temperature	7	TePHYSIOLOG.	°C	10		0+44°C		
24	459	454	16	Linear analogue signal - CO Gas concentration	80	Conc-gasCO	ppm	10	300	60 +300mV	Param1 60 Param2 300	Param3 0 Param4 4000
25	487	482	7	Linear analogue signal - Air temperature	130	TeAIR	°C	3		60+300mV	Param1 60 Param2 300	Param3 -10 Param4 60
26	511	505	8	Linear analogue signal - Relative Humidity	21	RelHUMidity	%	3	3	60+300mV	Param1 60 Param2 300	Param3 0 Param4 100
27	536	530	17	Linear analogue signal - SO2 Gas concentration	85	Conc-gasSO2	ppm	10	300	60+300mV	Param1 60 Param2 300	Param3 0 Param4 100
28	562	556	18	Linear analogue signal - CO2 Gas concentration	81	Conc-gasCO2	ppm	30	300	60+300mV	Param1 60 Param2 300	Param3 0 Par.4 30000
29	590	584	19	TR Pt100 SMPT68-IEC751 - Ankles temperature	122	TeANKLes	°C	10		-50+600°C		
			191	- Vertical air temp. diff. between head and ankles calculation	119	DIssatTeVert	%	10		0..100%		
30	619	612	20	TR Pt100 SMPT68-IEC751 - Floor temperature	121	TeFLOOR	°C	10		-50+600°C		
			192	- Dissatisfied local discomfort caused by temp. floors calculation	118	DissatTeFLoor	%	10		0..100%		
31	642	635	21	TCJ ANSI-MC961 - General Temperature	1	Temperature	°C	10		-50+600°C		
32	673	666	22	TCJ ANSI-MC961 - Surface Temperature	6	TeSURFACE	°C	10		-50+600°C		
33	698	691	23	TCJ NBS125 - General Temperature	1	Temperature	°C	10		-50+600°C		
34	723	715	24	TCJ NBS125 - Surface Temperature	6	TeSURFACE	°C	10		-50+600°C		
35	750	742	25	TCK ANSI-MC961 - General Temperature	1	Temperature	°C	10		-50+1300°C		
36	777	769	26	TCK ANSI-MC961 - Surface Temperature	6	TeSURFACE	°C	10		-50+1300°C		
37	806	797	27	TCS ANSI-MC961 - General Temperature	1	Temperature	°C	10		0+1600°C		

38	835	826	28	TCS ANSI-MC961 - Surface Temperature	6	TeSURFACE	°C	10		0+1600°C		
39	866	857	29	TCT ANSI-MC961 - General Temperature	1	Temperature	°C	10		-200+200°C		
40	898	889	30	TCT ANSI-MC961 - Surface Temperature	6	TeSURFACE.	°C	10		-200+200°C		

follows TABLE OF OPERATIVE CODES 41 TO 50

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
41	931	921	31	Linear analogue signal - Relative humidity	21	RelHUMidity	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
			152	- Dew point calcultation. ISO 7726 of %	19	TeDewPoint	°C	10		-50+150°C				
			195	- Heat Index calculation	126	HeatIndex	°C	10						
			196	- Heat discomfort calculation	127	HeatDISComf.		10						
42	965	955	32	Analogue signal linearized for RHCapacitive curve - Relative humidity	21	RelHUMidity	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
			152	- Dew point calcultation. ISO 7726 of %	19	TeDewPoint	°C	10		-50+150°C				
			195	- Heat Index calculation	126	HeatIndex	°C	10						
			196	- Heat discomfort calculation	127	HeatDISComf.		10						
43	1000	990	33	Linear analogue signal - Relative humidity	21	RelHUMidity	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
44	1040	1029	34	Linear analogue signal - Wind direction	39	ANGLE	°<	5	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 360
45	1090	1078	38	Linear analogue signal - Deferential pressure 0 .. 12,5	44	PressDIF	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 12,5
			159	- Air speed calculation by Pitot tube	35	AIR Spass	m/s	10		0 / 45,0 m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
46	1130	1118	35	Linear analogue signal - Wind speed with verse	38	VelWIND	m/s	5	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 50
			168	- Air delivery volume calculation	98	AirDELiveryVol	m3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
			170	- Number of air changes calculation	100	AirCHAnges	N/h	10		Variable				
47	1180	1168	36	TR Potentiometer 360° (0..2 kohm) - Wind direction	39	ANGLE	<	5		0+2000	Param1 Param2	0 2000	Param3 Param4	0 360
48	1230	1217	37	Linear analogue signal - Differential pressure 0-2.54	44	PressDIFfer.al	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 2,54
			159	- Air speed calculation by Pitot tube	35	PressDIF	m/s	10		0 / 20,0 m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variabile				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variabile				
49	1270	1257	39	Linear analogue signal - Differential pressure 0-70	44	PressDIFfer.al	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 70
			159	- Air speed calculation by Pitot tube	35	PressDIF	hPa	10	2	0 .. 109 m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
50	1320	1307	40	Linear analogue signal - Atmospheric pressure	42	PressAtmosphe.	hPa	10	2	60 +300mV	Param1 Param2	60 300	Param3 Param4	800 1100

follows TABLE OF OPERATIVE CODES 51 TO 65

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
51	1370	1357	41	Linear analogue signal - Lux measurement with CIE Vlamda filtering	32	ILLUMINATION	Lux	10	0	0+100mV	Param1 Param2	60 300	Param3 Param4	0 5000
			175	- Intensity light calculation	108	IntensLIGHt	cd	10		Variable				
			194	- Daylight factor calculation	123	DaylightFactor	%	10		0+100				
52	1420	1406	42	Linear analogue signal - Lux measurement with CIE Vlamda filtering; indoor	32	ILLUMINATION	Lux	10	2	0+300mV	Param1 Param2	0 300	Param3 Par.4	0 25000
			175	- Intensity light calculation	108	IntensLIGHt	cd	10		Variable				
			194	- Daylight factor calculation	123	DaylightFactor	%	10		0+100				
53	1470	1456	43	Linear analogue signal - Lux measurement with CIE Vlamda filtering; outdoors	33	ILLUMINATION	kLux	10		0+100mV	Param1 Param2	0 100	Param3 Param4	0 100
			175	- Intensity light calculation	108	IntensLIGHt	cd	10		Variable				
54	1520	1506	44	Linear analogue signal - Lux measurement with CIE Vlamda filtering; outdoors	33	ILLUMINATION	kLux	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
			175	- Intensity light calculation	108	IntensLIGHt	cd	10		Variable				
55	1580	1566	45	Log10 analogue signal - Soil resistence	103	SOILResist	kohm	600	60	60+300mV	Param1 Param2	0 100	Param3 Param4	0,1 1000
56	1640	1625												
57	1690	1675	47	TCT Thermopile - Total radiation (with calibration factor)	23	RadGLOBAL	W/m²	10		0+20mV	Param1 Param2	0 20	Param3 Param4	0 1500
58	1740	1725	48	Linear analogue signal - Total radiation	23	RadGLOBAL	W/m²	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 1500
59	1800	1785	49	TCT Thermopile - Net radiation (with calibration factor)	24	RadNET	W/m²	10		-10+15mV	Param1 Param2	-10 15	Param3 Param4	-1000 1500
60	1870	1854	50	TCT Thermopile - Direct radiation (with calibration factor)	25	RadDIRect	W/m²	10		0+20mV	Param1 Param2	0 20	Param3 Param4	0 1500
61	1930	1914	51	Linear analogue signal - Direct radiation	25	RadDIRect	W/m²	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 1500
62	2000	1984	52	TCT Thermopile - Diffused radiation (with calibration factor)	26	RadSCATTERED	W/m²	10		0+20mV	Param1 Param2	0 20	Param3 Param4	0 1500
63	2050	2033	49	TCT Thermopile - Net radiation (with calibration factor)	25	RadNET	W/m²	10		-10+15 mV	Param1 Param2	-10 15	Param3 Param4	-1000 1500
			29	TCT ANSI-MC961 - Absolute temperature of thermopile	1	Temperature	°C	10		-200+200°C				
			155	- Calculation of flat radiating asymmetry ISO 7726	13	TeAsymRadPlan.	°C	10		-50+150°C				
			193	- Dissat.radiant temp.asymmetry on 2 axle Horiz/Vert calculation	120	DIssatTeAsRAD	%	10		0..100%				
64	2100	2083	53	Linear analogue signal - Lux measurement with CIE Vlamda filtering; outdoors	33	ILLUMINATION	Lux	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 6000
			175	- Intensity light calculation	108	IntensLIGHt	cd	10		Variable				
65	2150	2133	54	Linear analogue signal - VIR filtered radiation	29	RadVIR	W/m²	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 200

follows TABLE OF OPERATIVE CODES 66 TO 80

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
66	2210	2192	55	Linear analogue signal - UVA filtered radiation	27	RadUVA	uW/m^2	10	0	0+300mV	Param1 Param2	0 300	Param3 Par.4	0 60000
			176	- UVA density calculation	109	UVADensity	uW/lm	10		Variable				
67	2260	2242	56	Linear analogue signal - PAR filtered radiation	30	RadPAR	W/m^2	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 1500
68	2320	2302	57	Linear analogue signal - UVA filtered radiation	27	RadUVA	W/m^2	10		0+300mV	Param1 Param2	0 300	Param3 Param4	0 70
69	2400	2382	58	Linear analogue signal - UVA filtered radiation	27	RadUVA	W/m^2	10	2	0 +300mV	Param1 Param2	0 300	Param3 Param4	0 20
70	2490	2471	59	Linear analogue signal - UVB filtered radiation	28	RadUVB	W/m^2	10	2	0 +300mV	Param1 Param2	0 300	Param3 Param4	0 5
			188	- UV Index calculation	124	UVIndex				Variabile				
			189	- UV Exposure Level calculation	125	UVEXPosLevel				Variabile				
71	2550	2531	60	Linear analogue signal - Level	50	LIVEL	mm	10	2	60 300 mV	Param1 Param2	60 300	Param3 Param4	0 204,4
72	2610	2590	61	Linear analogue signal - Thermal flow	31	FLUX TERMICO	W/m^2	10		-10+120mV	Param1 Param2	-10 120	Param3 Param4	-125 1500
			171	- Global conductance calculation UNI 7357	104	conducKGLobB	W/(m^{2}K)	10		Variable				
			172	- Surface ext / ext. air conductance calculation UNI 7357	105	condKSuExt	W/(m^{2}K)	10		Variable				
			173	- Surface int / int. air conductance calculation UNI 7357	106	CondKSuInt	W/(m^{2}K)	10		Variable				
73	2670	2650	62	Linear analogue signal - Level	50	LEVEL	m	10	2	60 +300mV	Param1 Param2	60 300	Param3 Param4	0 10,22
74	2740	2720	63	Linear analogue signal - Level	50	LEVEL	m	10	2	60 +300mV	Param1 Param2	60 300	Param3 Param4	0 20,44
75	2810	2789	64	Linear analogue signal - CO Gas concentration	80	Conc-gasCO	ppm	10	300	60 +300mV	Param1 Param2	60 300	Param3 Param4	0 1000
76	2870	2849	65	Linear analogue signal - NO Gas concentration	83	Conc-gasNO	ppm	10	300	60 +300mV	Param1 Param2	60 300	Param3 Param4	0 100
77	2940	2919	66	Linear analogue signal - NO2 Gas concentration	84	Conc-gasNO2	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 20
78	3050	3028	67	Linear analogue signal - SO2 Gas concentration	85	Conc-gasSO2	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 20
79	3120	3098	68	Linear analogue signal - NH3 Gas concentration	86	Conc-gasNH3	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 50
80	3200	3178	69	Linear analogue signal - H2S Gas concentration	87	Conc-gasH2S	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 50

follows TABLE OF OPERATIVE CODES 81 TO 95

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
81	3280	3257	70	Analogue signal linearized for CO2 curve - CO2 Non-linear gas concentration probe	81	Conc-gasCO2	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 3000
82	3360	3337	71	Linear analogue signal - HCL Gas concentration	88	Conc-gasHCL	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
83	3440	3416	72	Linear analogue signal - O2 Gas concentration	90	Conc-gasO2	%	10	300	0+300mV	Param1 Param2	0 300	Param3 Param4	0 25
84	3520	3496	73	ON/OFF circuit - Useable only as actuator	77	ASPIRation		10	30	0 + 300 mV Threshold 150	State Off State On	300 0	Threshold 150 YES<150> NO	
85	3610	3585	74	Linear analogue signal - CO2 Gas concentration	81	Conc-gasCO2	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 3000
86	3700	3675	75	Linear analogue signal - Cl2 Gas concentration	92	Conc-gas Cl2	ppm	10	30m	60+300mV	Param1 Param2	60 300	Param3 Param4	0 20
87	3790	3765	76	Linear analogue signal - H2 Gas concentration	93	Conc-gas H2	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 2000
88	3880	3854	77	Linear analogue signal - Temperature	1	Temperature	°C	10	2	60 +300 mV	Param1 Param2	60 300	Param3 Param4	-30 70
89	3970	3944	78	Status of On/Off circuit - Presence, state, general conditions	46	Presence		10		0 + 300 mV Threshold 150	State Off State On	300 0	Threshold 150 YES<150> NO	
90	4070	4043	79	Status of On/Off circuit - Presence of precipitation	47	PreszPRECIP.ON		10		0 + 300 mV Threshold 150	State Off State On	300 0	Threshold 150 YES<150> NO	
91	4170	4143	80	Status of On/Off circuit - Presence of wetness	48	PreszWETTING		10		0 + 300 mV Threshold 150	State Off State On	300 0	Threshold 150 YES<150> NO	
92	4270	4242	81	Linear analogue signal - Differential pressure 0 ..1 hPa	44	PressDIFfer.al	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 1
			159	- Air speed calculation by Pitot tube	35	PressDIF	hPa	10	2	0 .. 15m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
93	4370	4342	82	Linear analogue signal - Differential pressure 0 ..330 hPa	44	PressDIFfer.al	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 330
			159	- Air speed calculation by Pitot tube	35	PressDIF	hPa	10	2	0 .. 250m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
94	4590	4561	83	Linear analogue signal - Differential pressure 0 ..25 hPa	44	PressDIFfer.al	hPa	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 25
			159	- Air speed calculation by Pitot tube	35	PressDIF	hPa	10	2	0 .. 65 m/s	Param1 Param2	0 250	Param3 Param4	0 250
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
95	4700	4670	84	Linear analogue signal - Sound level	75	SOuNDLevel	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	0 140

follows TABLE OF OPERATIVE CODES 96 TO 115

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
96	4810	4779	113	Linear analogue signal - pH adjusted by solution temperature	94	PH	pH	10	5	0 + 14 pH	Param1 Param2	60 300	Param3 Param4	0 14
97	4930	4899	114	TS TS1-LSI LASTEM - General Temperature	1	Temperature	°C	10		-50+50°C				
98	5050	5018	115	TCE ANSI-MC961 - General Temperature	1	Temperature	°C	10		-200+1000°C				
99	5170	5119	116	Linear analogue signal - O3 Gas Concentration	97	Conc-gasO3	ppm	10	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 3
100	5490	5437	117	Linear analogue signal - Displacement	102	DISPLacement	mm	10	5	60+300mV	Param1 Param2	60 300	Param3 Param4	-2,0 2,0
101	5830	5775	118	Linear analogue signal Sound level slow, weight C	76	LEVsndSlowC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	10 100
102	6120	6064	119	Linear analogue signal Sound Level Fast, weight C	74	LEVsndFastC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	10 100
103	6420	6362	120	Linear analogue signal - Sound Lev slow, weight A	75	LEVsndSlowA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	10 100
104	6730	6671	121	Linear analogue signal - Sound level fast, weight A	73	LEVsndFastA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	10 100
105	7060	6999	122	Linear analogue signal - Sound level slow, weight C	76	LEVsndSlowC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	30 120
106	7410	7347	123	Linear analogue signal -Sound level fast, weight C	74	LEVsndFastC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	30 120
107	7770	7706	124	Linear analogue signal -Sound level slow, weight A	75	LEVsndSlowA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	30 120
108	8060	7994	125	Linear analogue signal -Sound level fast, weight A	73	LEVsndFastA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	30 120
109	8350	8283	126	Linear analogue sensor -Sond level slow, weight C	76	LEVsndSlowC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	50 140
110	8660	8591	127	Linear analod sensor -Sound level fast, weight C	74	LEVsndFastC	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	50 140
111	8980	8910	128	Linear analogue signal -Sound level slow, weight A	75	LEVsndSlowA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	50 140
112	9310	9238	129	Linear analogue signal - Sound level fast,weight A	73	LEVsndFastA	dB	2		0+300mV	Param1 Param2	0 300	Param3 Param4	50 140
113	9650	9576	130	Linear analogue signal - Pressure	41	PRESSURE	Bar	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 30
114	10000	9925	131	Linear analogue signal - Speed air high resolution	115	Vel.AIRHR	m/s	6	6	60+300mV	Param1 Param2	60 300	Param3 Param4	0 20
115	10400	10323	132	Linear analogue signal - Intensity of turbulence of the air	116	TUrbolence	%	6	6	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
			190	- Draught Risck of air movement calculation	117	DRair	%	6		0..100.0 %				

follows TABLE OF OPERATIVE CODES 131 TO 145

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
116	10900	10820	133	Linear analogue signal - CH4 Gas concentration	128	Conc-gasCH4	% LEL	30	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 1
117	11300	11218	134	Linear analogue signal - COV Gas concentration	129	Conc-gasVOC	ppm	30	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 20
118	11700	11616	135	Linear analogue signal - COV Gas concentration	129	Conc-gasVOC	ppm	30	300	60+300mV	Param1 Param2	60 300	Param3 Param4	0 2000
131	16200	16094												
132	16700	16591	111	Volt internal battery - General	101	BATTery	V	60		0+15 V				
133	17200	17089	112	Linear resistence - Generral	79	RESistence	ohm	2		0+20000 ohm	Param1 Param2	0 20000	Param3 Par.4	0 20000
136	18400	18283	87	Linear analogue signal - General	54	SIG1:	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
137	18700	18581	88	Linear analogue signal - General	55	SIG2:	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
138	19100	18979	89	Linear analogue signal - General	56	SIG3:	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
139	19600	19477	90	Linear analogue signal - General	57	SIG4:	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
140	20000	19875	91	Linear analogue signal - General	58	SIG5:	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
141	20500	20372	92	Linear analogue signal - General	59	SIG6:	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
142	21000	20870	93	Linear analogue signal - General	60	SIG7:	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
143	21500	21367	94	Linear analogue signal - General	61	SIG8:	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100
144	22000	21865	95	Linear analogue signal - General	62	SIG9:	%	10	2	0+300mV	Param1 Param2	0 300	Param3 Param4	0 100
145	22600	22462	96	Linear analogue signal - General	63	SIG0:	%	10	2	60+300mV	Param1 Param2	60 300	Param3 Param4	0 100

follows TABLE OF OPERATIVE CODES 151 TO 160 Input 10 (impulsive)

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters			
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input		Output	
151	510		97	Impulsive signal linearized for TacoC100S curve - Wind speed (frequency)	38	Vel.WIND	m/s	5		0/564	Param1 Param2	0 50	Param3 Param4	0 50
152	1100		98	Impulsive signal linearized for Ventolina curve - Absolute air speed (frequency)	35	Vel.AIRabsolute	m/s	10		0/2560Hz	Param1 Param2	0 2560	Param3 Param4	0 20
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
			170	- Number of air changes calculation	100	AirCHAnges	N/h	10		Variable				
153	1800		99	Linear impulse signal - Amount of precipitation (totalization)	45	QuantPRECIP.ON	mm	10		0/65000	Param1 Param2	0 65000	Param3 Par.4	0 13000
154	2700		100	Linear impulsive signal - General (Frequncy)	53	FREQuency	Hz	2	2	0/100000 Hz	Param1 Param2	0 99999	Param3 Par.4	0 99999
			160	- General (totalization)	53	COUNTER	Nr	2		0/999999 Hz	Param1 Par.2	0 999999	Param3 Par.4	0 999999
			161	- General (totalization)	53	COUNTER	Nr	2		0/999999 Hz	Param1 Par.2	0 999999	Param3 Par.4	0 999999
155	3600		101	Impulsive signal linearized for TacoAnem curve - Wind speed (frequency)	38	Vel.WIND	m/s	5		0.... 1288 Hz	Param1 Param2	0 60	Param3 Param4	0 60
156	4700		102											
157	6200		103	Impulsive signal linearized for Ventoline BSV202 curve - Absolute air speed (frequency)	35	Vel.AIRabsolute	m/s	10		0/514Hz	Param1 Param2	0 25	Param3 Param4	0 25
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
			170	- Number of air changes calculation	100	AirCHAnges	N/h	10		Variable				
158	8200		104	Impulsive signal linearized for Taco BSV001 curve - Wind speed (frequency)	38	Vel.WIND	m/s	5		0/241 Hz	Param1 Param2	0 50	Param3 Param4	0 50
159	10000		105	Impulsive signal linearized for Miniair60 curve (40 m/sec) - Air speed (Frequency)	35	Vel.AIRabsolute	m/s	10	0	0/40,00 m/s				
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
			170	- Number of air changes calculation	100	AirCHAnges	n/h	10		Variable				
160	12000		106	Impulsive signal linearized for Miniair60 curve (20m/sec) - Air speed (Frequency)	35	Vel.AIRabsolute	m/s	10	0	0/20,00 m/s				
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable				
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable				
			170	- Number of air changes calculation	100	AirCHAnges	n/h	10		Variable				

follows TABLE OF OPERATIVE CODES 161 input 9 anemometer e 162 input 11 voltage

161	Ingresso 9		107	Special signal LSI LASTEM - Hot wire anemometer of dedicated input	35	AIRSPEED	m/s	2		0/50 m/s	Param1 0 Param2 50	Param3 0 Param4 50
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable		
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable		
			170	- Number of air changes calculation	100	AirCHAnges	N/h	10		Variable		
162	Ingresso 11		108	Analogueic signal -4+4V - Generic (on dedicated input)	64	SIGZ:	mV	10		-4000 + 4000	Param1 -4000 Param2 4000	Param3 -4000 Param4 4000

follows TABLE OF SECONDARY OPERATIVE CODES 151 TO 169

Codes calculated by BABUC from the using of some kind of probes. Each secondary code can be connected (by the LSI LASTEM technician) to a specific type of probe; each probe can receive max. 2 secondary codes.

Oper Cod.	Recognition resistance Ω		S/ op	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters	
	Nomin.	Min	cod	Physical-electrical type,reference standard,application	N°	Text		sec.	sec		Input	Output
			151	- Psychrometric relative humidity calculation, ISO 7726	21	RelHUMidity	%	10		0 100%		
			152	- Dew point calcultation. ISO 7726	19	TeDewPoint	°C	10		-50 +150°C		
			153	- Mean radiant temperature ISO 7726	11	TeMeanRadiant	°C	10		-50 + 150		
			154	- Partial vapour pressure calculation, ISO7726	43	PressParzVapor	hPa	10		0 +1000 hPa		
			155	- Planar asymetric radiant temperature calculation, ISO7726	13	TeAsymRadPlan	°C	10		-50 + 150°C		
			156	- Mean planar radiant temperature calculation, ISO 7726	13	TeMeanRadPlan	°C	10		-50 + 150°C		
			157	- Wall temperature calculation 1, ISO 7726	14	TeWall1	°C	10		-50 ... +150°C		
			158	- Wall temperature calculation 2, ISO 7726	14	TeWall2	°C	10		-50 ... +150°C		
			159	- Air speed calculation by Pitot tube	35	VelAIRabsolute	m/s	10		0 109,0 m/s	Param1 0 Param2 250	Param3 0 Param4 250
			160	- Generic (Integrating meter into the interval of acquisition)	53	CouNTeRPart	Nr	2	2	0 999999	Param1 0 Par.2 999999	Param3 0 Par.4 999999
			161	- Generic (Integrating meter from the start of the survey)	72	CouNTeRTotal	Nr	2	2	0 999999	Param1 0 Par.2 999999	Param3 0 Par.4 999999
			162	- Wind direction	39	DirWIND	<	5		0 360 °		
			163	-								
			164	- Dew point calcultation. ISO 7726	19	TeDewPoint	°C	10		-50+150°C		
			165	-								
			166	- WBGT int calcultation ISO 7243	95	WBGTInt	°C	10		-50+150°C		
			167	- WBGT ext calcultation ISO 7243	96	WBGTExt	°C	10		-50+150°C		
			168	- Air delivery volume calculation	98	AirDELiveryVol	m^3/s	10		Variable		
			169	- Air delivery mass calculation	99	AirDELiveryMas	kg/s	10		Variable		

follows TABLE OF SECONDARY OPERATIVE CODES 170 TO 194

Oper Cod.	Recognition resistance Ω		S/ op cod	Analytical description of value	Full text on print-out		Unit	Def. acq.	Def. act.	Range of measure	Default In ->out parameters	
	Nomin.	Min		Physical-electrical type,reference standard,application		Text		sec.	sec		Input	Output
			170	- Number of air changes calculation	100	AirCHAnges	N/h	10		Variable		
			171	- Global conductance calculation UNI 7357	104	conducKGLoB	W/(m²K)	10		Variable		
			172	- Surface ext / ext. air conductance calculation UNI 7357	105	condKSuExt	W/(m²K)	10		Variable		
			173	- Surface int / int. air conductance calculation UNI 7357	106	condKSuInt	W/(m²K)	10		Variable		
			174	- Wall conductance calculation UNI 7357	107	condKSuWall	W/(m²K)	10		Variable		
			175	- Intensity ligth calculation	108	IntensLIGTH	cd	10		Variable		
			176	- UVA Density calculation	109	UVADensity	uW/lm	10		Variable		
			177	- CET Internal calculation	110	CETInt	°C	10		Variable		
			178	- CET External calculation	111	CETExt	°C	10		Variable		
			179	-								
			180	-								
			181	-								
			182	-								
			183	-								
			184	- Absolute humidity calculation, ISO 7726	22	AbsHUMidity	g/m³	10		Variable		
			185	- Specific humidity calculation, ISO 7726	112	SpecificHUMidity	g/kg	10		Variable		
			186	- Humidity ratio calculation ISO 7726	113	HUMidityRAtio	g/kg	10		Variable		
			187	- Most air entalppy calculation Ashrae	114	ENTALpy	kJ/kg	10		Variable		
			188	- UV Index calculation	124	UVIndex				Variable		
			189	- UV Exposure Level calculation	125	UVEXPosLevel				Variable		
			190	- Draught Risck of air movement calculation UNI EN ISO 7730	117	DR	%	6		0..100.0		
			191	- Dissatisfied local discomfort caused by temp. floors calculation	118	DissatTeFLoor	%	10		0..100.0		
			192	- Vertical air temp. diff. between head and ankles calculation	119	DissatTeVert	%	10		0..100.0		
			193	- Dissat.radiant temp.asymmetry on 2 axle Horiz/Vert calculation	120	DIssatTeAsRAD.	%	10		0..100.0		
			194	- Daylight factor calculation	123	DaylightFactor.	%	10		0..100.0		
			195	- Heat Index calculation	126	HeatIndex	°C	10		Variable		
			196	- Heat discomfort calculation	127	HeatDISComf.		10		Variable		

TABELLA DI RICERCA DEI CODICI OPERATIVI PER I SENSORI LSI LASTEM
QUICK REFERENCE TABLE FOR LSI LASTEM SENSORS OPERATION CODES

Cod.sensore SensorCode	Cod/Op Op/Cod
pH	
BSF010	96
Concentrazione gas Gas Concentration	
BSO091	24
BSO101	75
BSO102	28
BSO103	81
BSO103.1	85
BSO104	76
BSO108	77
BSO111	78
BSO112	27
BSO115	79
BSO119	80
BSO123	82
BSO129	86
BSO132	87
BSO140	83
BSO146	99
BSO150	117
BSO152	118

Cod.sensore SensorCode	Cod/Op Op/Cod
Pressione Pressure	
BSP002	50
BSP010	92
BSP011	48
BSP012	49
BSP014	45
BSP015	94
BSP016	93
BSP501	113
Radiometria Luxmet. Radiation Illumination	
BSR000	51
BSR001	52
BSR003	54

Cod.sensore SensorCode	Cod/Op Op/Cod
BSR007	68
BSR009	70
BSR015	67
BSR020	65
BSR030	58
BSR107	64 Lux 66 UVA
BSR231	63
BSR240	72
BSR250	72
Temperatura Temperature	
BST101	15
BST102	15
BST104	15
BST105	15
BST107	15
BST110	21
BST116	15
BST118	15
BST120	15
BST122	15
BST125	21

Cod.sensore SensorCode	Cod/Op Op/Cod
BST127	15
BST130	29CavAn 30Pav/Fl
BST131	18
BST201	35
BST204	36
BST205	36
BST216	35
BST218	35
BST220	36
BST221	36
BST224	36
BST225	36
BST301	39
BST701	23
BST801	36 K

Cod.sensore SensorCode	Cod/Op Op/Cod
Livello sonoro Noise level	
BNB464 A	101 a / to 112
BNB464 B	95
Tachimetria/ Tachimeter	
BSV301	154
BSV401	154
Umidità relativa/ Relative humidity	
BSU102	11
BSU104	11
BSU106	12
BSU121	17
BSU400 BSU401	16 Ta 42 Rh
BSU402 BSU403	16 Ta 42 Rh
BSU402.1 BSU403.1	16 Ta 41 Rh

Cod.sensore SensorCode	Cod/Op Op/Cod
BSU431	16 Ta 42 Rh
Anemometria Air speed	
BSV001	158
BSV101	161
BSV111	46
BSV102	22 Va 25 Ta 26 Rh
BSV105	114 Va 115 TU
BSV105	115 TU
BSV201	152
BSV202	157
BSV207	160
BSV209	159
DNA001	151
DNA010	47
DNA021	155 Vel 47 Dir
DNA501	46
DNA510	44